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OPERATION MANUAL

SYSTEMS, INC.

MODE S
TEST SYSTEM

OPERATION MANUAL

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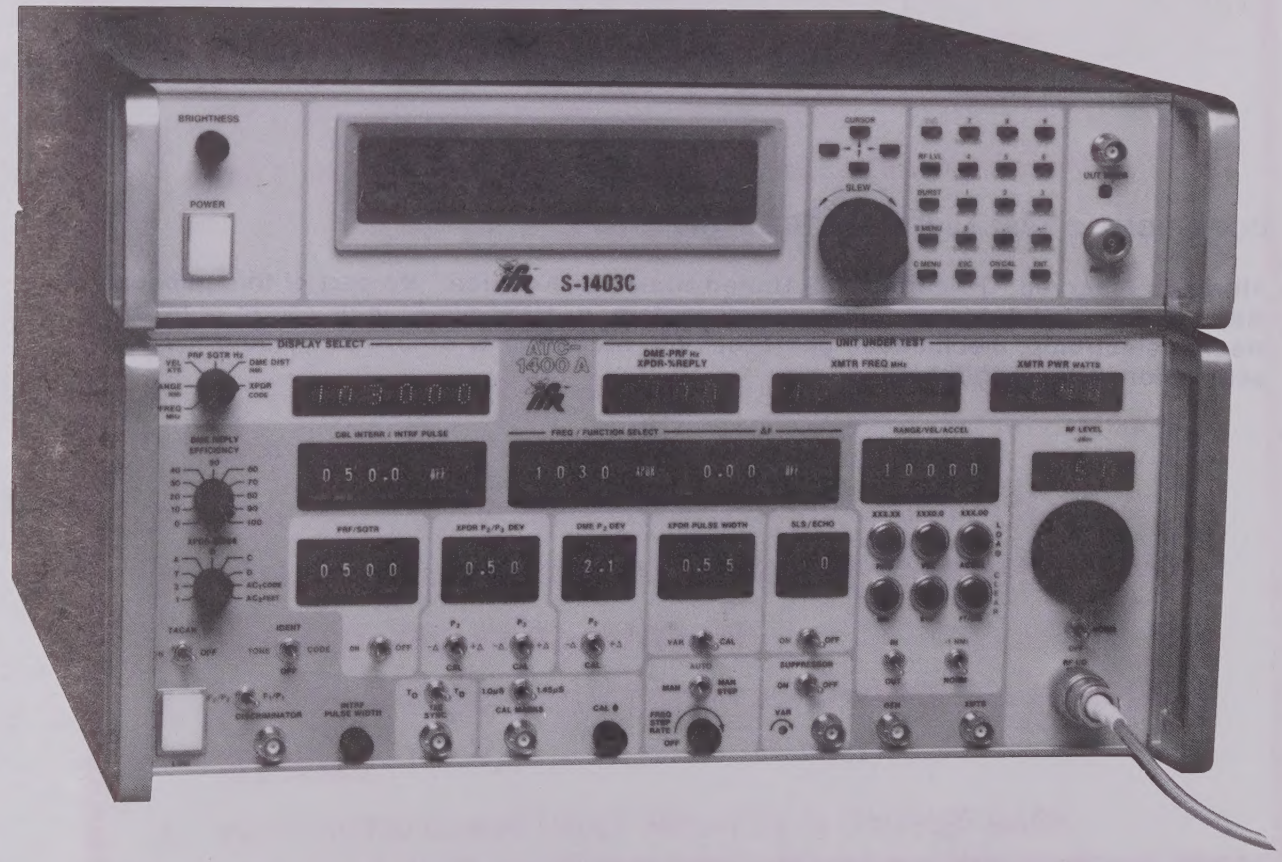
TEST SYSTEM



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OPERATION MANUAL
MODE S TEST SYSTEM

PUBLISHED BY
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WARNING

HIGH VOLTAGE EQUIPMENT

THIS EQUIPMENT CONTAINS CERTAIN CIRCUITS AND/OR COMPONENTS OF EXTREMELY HIGH VOLTAGE POTENTIALS, CAPABLE OF CAUSING SERIOUS BODILY INJURY OR DEATH. WHEN PERFORMING ANY OF THE PROCEDURES CONTAINED IN THIS MANUAL, HEED ALL APPLICABLE SAFETY PRECAUTIONS.

RESCUE OF SHOCK VICTIMS

1. DO NOT ATTEMPT TO PULL OR GRAB THE VICTIM.
2. IF POSSIBLE, TURN OFF THE ELECTRICAL POWER.
3. IF YOU CANNOT TURN OFF ELECTRICAL POWER, PUSH, PULL OR LIFT THE VICTIM TO SAFETY USING A WOODEN POLE, ROPE OR SOME OTHER DRY INSULATING MATERIAL.

FIRST AID

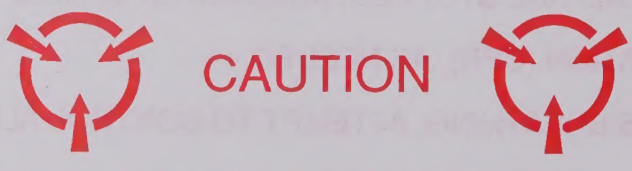
1. AS SOON AS VICTIM IS FREE OF CONTACT WITH SOURCE OF ELECTRICAL SHOCK, MOVE VICTIM A SHORT DISTANCE AWAY FROM SHOCK HAZARD.
2. CALL FOR DOCTOR AND/OR AMBULANCE, IMMEDIATELY.
3. IF BREATHING HAS STOPPED; ADMINISTER CARDIO-PULMONARY RESUSCITATION (CPR), AS NEEDED.
4. IF VICTIM IS BREATHING, ATTEMPT TO CONTROL ALL SERIOUS BLEEDING.
5. KEEP VICTIM WARM, QUIET AND FLAT ON HIS/HER BACK.

CAUTION: INTEGRATED CIRCUITS AND SOLID STATE DEVICES SUCH AS MOS FETS, ESPECIALLY CMOS TYPES, ARE SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGES RECEIVED FROM IMPROPER HANDLING, THE USE OF UNGROUNDED TOOLS AND IMPROPER STORAGE AND PACKAGING. ANY MAINTENANCE TO THIS UNIT MUST BE PERFORMED WITH THE FOLLOWING PRECAUTIONS:

- BEFORE USE IN A CIRCUIT, KEEP ALL LEADS SHORTED TOGETHER EITHER BY THE USE OF VENDOR-SUPPLIED SHORTING SPRINGS OR BY INSERTING LEADS INTO A CONDUCTIVE MATERIAL.
- WHEN REMOVING DEVICES FROM THEIR CONTAINERS, GROUND THE HAND BEING USED WITH A CONDUCTIVE WRISTBAND.
- TIPS OF SOLDERING IRONS AND/OR ANY TOOLS USED MUST BE GROUNDED.
- DEVICES MUST NEVER BE INSERTED INTO NOR REMOVED FROM CIRCUITS WITH POWER ON.
- PC BOARDS, WHEN TAKEN OUT OF THE SET, MUST BE LAID ON A GROUNDED CONDUCTIVE MAT OR STORED IN A CONDUCTIVE STORAGE BAG. REMOVE ANY BUILT-IN POWER SOURCE, SUCH AS A BATTERY, BEFORE LAYING PC BOARDS ON A CONDUCTIVE MAT OR STORING IN A CONDUCTIVE BAG.
- PC BOARDS, IF BEING SHIPPED TO THE FACTORY FOR REPAIR, MUST BE PACKAGED IN A CONDUCTIVE BAG AND PLACED IN A WELL-CUSHIONED SHIPPING CONTAINER.

CAUTION: THE USE OF SIGNAL GENERATORS FOR MAINTENANCE AND OTHER ACTIVITIES CAN BE A SOURCE OF ELECTROMAGNETIC INTERFERENCE TO AVIATION RECEIVERS, WHICH CAN CAUSE DISRUPTION AND INTERFERENCE TO AERONAUTICAL SERVICE OUT TO A DISTANCE OF SEVERAL MILES.

CAUTION: USERS OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION WHICH RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND ENSURE COMPLIANCE WITH INSTRUCTIONS IN FAA CIRCULAR AC 170-6C, DATED FEBRUARY 19, 1981.



RECORD OF REVISIONS

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INTRODUCTION - MODE S TEST SYSTEM

This manual contains the information necessary to install, evaluate and operate the Mode S Test System consisting of the S-1403C Test Auxiliary (with or without the Multi-Level Diversity option installed) and ATC-1400A Transponder/DME Test Set. The Mode S Test System Operation Manual is designed for use with the ATC-1400A Operation Manual.

It is strongly recommended that personnel be thoroughly familiar with the contents of this manual and the contents of the ATC-1400A Operation Manual before attempting to operate this equipment.

ORGANIZATION

This manual is divided into five sections as follows:

CHAPTER 1 - OPERATION

- Section 1 - DESCRIPTION (physical and mechanical description of S-1403C)
- Section 2 - OPERATION (installation; description of controls, connectors and indicators; performance evaluation; general operating procedures and remote operation)
- Section 3 - SPECIFICATIONS
- Section 4 - SHIPPING
- Section 5 - STORAGE

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4. General Operating Procedures

A. General

The General Operating Procedures contain instructions for operating the Mode S Test System using Front Panel controls (local operation). The General Operating Procedures identify controls, connectors, indicators and display screens used to perform the individual test functions. Refer to Unit Under Test (UUT) Manuals for specific UUT Test Procedures.

Remote communication with the Mode S Test System is provided by use of the General Purpose Interface Bus (GPIB) which conforms to IEEE Standard 488-1978. All communication with the Mode S Test System over the GPIB is implemented with ASCII encoded character strings. Refer to 1-2-5 for complete description of GPIB operation.

Refer to 1-2-2, Figure 6 for S-1403C (alphabetic character identifiers) controls, connectors and indicators. Refer to 1-2-2, Figure 7 for S-1403C Keyboard (B) references. Refer to 1-2-2, Figure 17 for ATC-1400A (numeric character identifiers) controls, connectors and indicators.

(1) System Characteristics

The Mode S Test System has seven operational functions as follows:

- ATCRBS (ATC) Test Function

  The Mode S Test System transmits standard ATCRBS interrogations. Replies are tested for accuracy, percent reply, frequency, power and reply delay. Interrogation pulse characteristics are varied to verify ATCRBS transponder receiver limitations.

- Sequence (SEQ) Test Function

  The Mode S Test System transmits standard Mode S interrogations. Up to sixteen programmable interrogations are sent in sequence. Interrogation pulse characteristics are varied to verify Mode S transponder receiver limitations. The S-1403C displays reply information.

- All-Call Short (ACS) Test Function

  The Mode S Test System transmits the ATCRBS Only All-Call (ATCRBS interrogation plus P_4 pulse at normal width) and provides reply information to verify the transponder operates correctly. Interrogation pulse characteristics including P_4 are varied to verify transponder receiver limitations.

- All-Call Long (ACL) Test Function

  The Mode S Test System transmits the ATCRBS/Mode S All-Call (ATCRBS interrogation plus wide P_4 pulse) and provides reply information to verify the transponder operates correctly. Interrogation pulse characteristics including P_4 are varied to verify transponder receiver limitations.

- Interlace (INTLCE) Test Function

  The Mode S Test System transmits ATCRBS interrogations interlaced with Mode S interrogations to verify transponder operation in a normal mixed environment.

- Double Interrogation (DI) Test Function

  The Mode S Test System transmits various combinations of closely spaced interrogations to verify transponder operation and recovery.

- BURST Test Function

  The Mode S Test System transmits ATCRBS or Mode S interrogation sequences at a set Pulse Repetition Frequency (PRF) to verify transponder reply rate capability.

Diversity testing is possible in all functions by enabling Antenna B (ANT B). The ability to switch antennas is tested by simulating disparity in amplitude or time from the Antenna A (ANT A) output through RF I/O Connector (9) to the ANT B output through ANT B Connector (E).

TEST FUNCTION PAGE

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ACS Test Function 21
ACL Test Function 30
INTLCE Test Function 39
DI Test Function 48
BURST Test Function 59

(2) System Considerations

Some Mode S or S-1403C functions are different from ATCRBS or ATC-1400A functions. Major differences and other considerations are as follows:

- The DISPLAY SELECT Readout (43) is not valid for Mode S replies.

- In ATCRBS test functions, when XPDR MODE Control (38) is set to AC_1, only Mode A interrogations are transmitted. When XPDR MODE Control (38) is set to AC_2, only Mode C interrogations are transmitted. The Mode S Test System does not transmit Mode A and Mode C interrogations alternately.

- S-1403C squitter display does not discriminate between dual antenna inputs (ANT A [ATC-1400A] and ANT B [S-1403C]).

- RF adjustments utilizing the SLEW Control (F) require 200 interrogations to stabilize. As PRF is set lower, stabilization time increases. The RF LEVEL Control (6) requires little or no stabilization time.

- The DME-PRF Hz XPDR-%REPLY Display (46) displays invalid reply percentages because of Mode S squitters. Accurate reply percentages are displayed in the S-1403C Control Menu #1 screen.

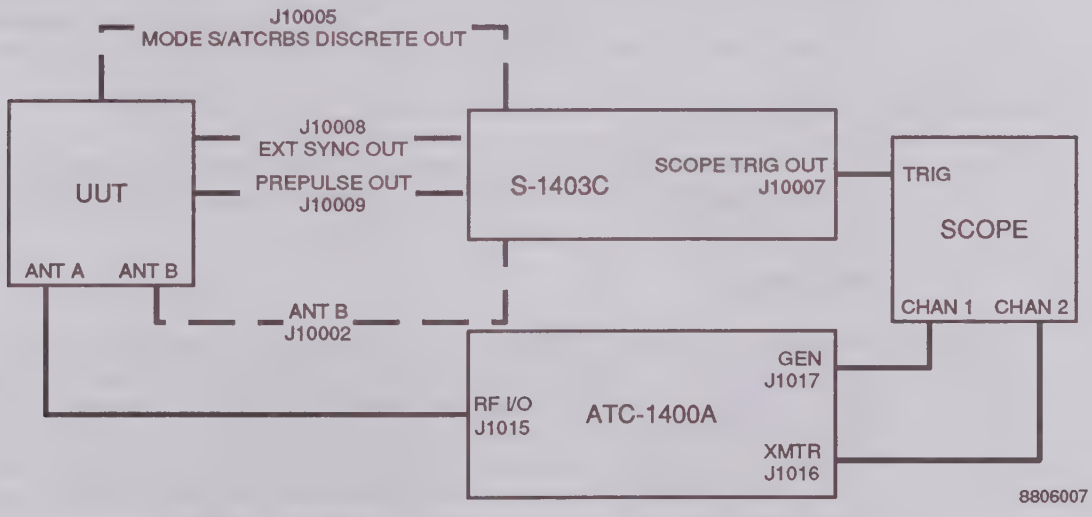
(3) Initial ATC-1400A Control Settings

Set ATC-1400A as follows:

CONTROL		SETTING
(7)	CW/NORM/OFF Switch	*NORM*
(18)	SLS/ECHO ON/OFF Switch	*OFF*
(22)	MAN/AUTO/MAN STEP Switch	*MAN*
(25)	XPDR DEV P_3/CAL Switch	*CAL*
(28)	XPDR DEV P_2/CAL Switch	*CAL*
(32)	PRF/SQTR ON/OFF Switch	*ON*
(37)	TACAN ON/OFF Switch	*OFF*
(38)	XPDR MODE Control	*A*
(40)	DISPLAY SELECT Control	*PRF SQTR Hz*
(41)	PRF/SQUITTER Thumbwheels	*0200*
(42)	DBL INTERR/INTRF Thumbwheels	*000.0 OFF*
(45)	FREQ/FUNCTION SELECT Thumbwheels	*1030 XPDR*
(48)	ΔF Thumbwheels	*OFF*

(4) Operational Hook-up

Refer to 1-2-4, Figure 24 for suggested hook-up used to operate the Mode S Test System. The Mode S Test System operational hook-up diagram is used with all test functions.



Mode S Test System Operational Hook-up Diagram
Figure 24

B. ATC Test Function

(1) Description

In the ATC Test Function, the Mode S Test System simulates an ATCRBS ground station transmitting standard two-pulse interrogations shown in Appendix F. Reply characteristics are measured to verify the ATCRBS transponder operates correctly.

(2) Procedure

STEP	PROCEDURE

1. Connect test equipment according to 1-2-4, Figure 24.

2. Apply power to Mode S Test System.

3. Select ATC Test Function. Press 2ND, FUN NO and "1" Keys in sequence or move cursor to Control Menu #1 ***Func:*** field and press "1" Key.

4. Set test parameters as follows:

MODE SELECTION

Select interrogation mode (***1***, ***2***, ***T***, ***A***, ***B***, ***C*** or ***D***) using XPDR MODE Control (38). Select ***AC_2*** for Mode C interrogations when decoded reply in feet is desired on DISPLAY SELECT Readout (43). ***AC_1*** is not used.

FREQUENCY

Adjust FREQ/FUNCTION Thumbwheels (45) and ΔF Thumbwheels (48) to set interrogation RF from ***952.01*** to ***1222.99*** MHz. Set to ***1030*** MHz for normal operation.

RF LEVEL

Adjust RF level from -130 to +3 dBm (-69 to -21 dBm is normal operating range) using RF LEVEL -dBm Display (3), RF LEVEL Control (6) and Control Menu #1 ***RFLvl:*** field. Adjust RF LEVEL Control (6) to set RF LEVEL -dBm Display (3) from ***127*** to ***0*** (-127 to 0 dBm). Press RF LVL Key to move cursor to Control Menu #1 ***RFLvl:*** field. Use Keyboard (B) or SLEW Control (F) to set ***RFLvl:*** field from ***-3.0*** to ***+3.0 dB*** to offset cable loss. Press ENT Key to enter selected value.

INTERROGATION RATE

Adjust PRF/SQTR Thumbwheels (41) to set interrogation rate or PRF from ***0*** to ***2400***. Set from ***0*** to ***500*** for normal operation.

STEP PROCEDURE

PULSE WIDTH

Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***CAL*** for 0.8 µs nominal width of P_1, P_2 (SLS) (if activated) and P_3 (if activated) interrogation pulses. Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***VAR*** and use XPDR PULSE WIDTH Thumbwheels (49) to adjust width from ***0.20*** to ***1.85*** µs.

P_2 (SLS) LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***ON***. Set P_2 (SLS) level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. Verify suppression occurs when P_2 level equals or exceeds P_1 level. Verify suppression does not occur when P_1 level exceeds P_2 level by 9 dB or more.

P_2 (SLS) POSITION

Set XPDR DEV P_2/CAL Switch (28) to ***CAL*** for nominal P_2 (SLS) position of 2.0 µs following P_1 leading edge. Set XPDR DEV P_2/CAL Switch (28) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to set position from 0.15 to 3.85 µs following P_1 leading edge.

P_3 LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***OFF***. Press 2ND and P3 Keys in sequence to move cursor to Control Menu #1 ***P3:*** field. Press ON/CAL Key to set ***P3:VAR***. Set P_3 level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. 0 dB is normal operating level (***P3:CAL***). When P_3 deactivation is desired, press ON/CAL Key to set ***P3:OFF***.

P_3 POSITION

Set XPDR DEV P_3/CAL Switch (25) to ***CAL*** for nominal P_3 position. Refer to Appendix F for nominal position. Set XPDR DEV P_3/CAL Switch (25) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to deviate position -1.85 to +1.85 µs from nominal.

INTERFERENCE PULSE

Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+***. Interference pulse is activated and positioned at -17.5 to +399.0 µs from leading edge of P_1. Set level from ***-19*** to ***+6*** dB (relative to P_1) using SLS/ECHO Thumbwheels (50). Set width from 0.2 to 5 µs using INTRF PULSE WIDTH Control (31).

SUPPRESSOR PULSE

Connect SUPPRESSOR OUTPUT Connector (16) to UUT suppressor input. Set SUPPRESSOR ON/OFF Switch (17) to ***ON*** to activate suppressor pulse. Adjust level from 3 to 27 V using SUPPRESSOR VAR Adjustment (19). When DBL INTERR/INTRF PULSE Thumbwheels (42) are ***OFF***, suppressor pulse position is 0.8 µs prior to SPR. Activate interference pulse to control position of suppressor pulse (suppressor pulse replaces interference pulse when both are activated). Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+*** to adjust suppressor pulse position from -17.5 to +399.0 µs relative to P_1. Width is fixed at 33 µs.

ANT B

Press 2ND and ANT B Keys in sequence to move cursor to Control Menu #1 ***AntB:*** field. Press ON/CAL Key to activate interrogations through ANT B Connector (E). Use SLEW Control (F) or Keyboard (B) to enter value from ***-0.95*** to ***+0.95*** (offset in 0.05 µs increments from ANT A interrogations).

If Multi-Level Diversity option is installed, set ANT B output level. Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Brf=*** and ***BrfIvl=*** fields. Using SLEW Control (F) or Keyboard (B), set ***Brf=*** field from ***-80*** to ***-20 dBm*** and ***BrfIvl=*** field from ***-3.0*** to ***+3.0 dB*** (used to offset cable loss).

5. If desired, set optional inputs and outputs as follows:

PREPULSE

Press 2ND and P PULS Keys in sequence to move cursor to Control Menu #2 ***Prepulse:*** field. Press ON/CAL Key to activate prepulse through PREPULSE OUT Connector (EE). Use SLEW Control (F) or Keyboard (B) to enter value from ***0*** to ***260*** (time in microseconds from prepulse leading edge to P_1 leading edge).

NOTE: Prepulse does not operate as specified when activated at the same time as external sync input.

EXT SYNC OUTPUT

Press 2ND and EXT SYN Keys in sequence to move cursor to Control Menu #2 ***Ext.Sync.:Out=*** subfield. Press ON/CAL Key to activate external sync pulse through EXT SYNC OUT Connector (CC). Use SLEW Control (F) or Keyboard (B) to set ***Ext.Sync.:,Dv=*** subfield value from ***-9.95*** to ***+9.95*** (time in microseconds from external sync pulse leading edge to P_1 leading edge) (**-**, P_1 follows external sync; **+**, external sync follows P_1).

STEP PROCEDURE

EXT SYNC INPUT

Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Ext.Sync.:,In=*** subfield. Press ON/CAL Key to set EXT SYNC IN Connector (BB) for external sync pulse input. Leading edge of P_1 occurs 7.0 µs after leading edge of external sync pulse. When external sync input is activated, external sync output is deactivated and associated subfields are blank. External sync input controls PRF and is limited same as internal PRF control.

EXT MODULATION INPUT

Press 2ND and EX MOD Keys in sequence to move cursor to Control Menu #2 ***Ext.Mod.In:*** field. Press ON/CAL Key to set ***Ext.Mod.In: ON***. Internal pulse modulation is deactivated. Interrogation is modulated by external modulation input through EXT MOD IN Connector (Z).

SCOPE TRIGGER OUTPUT

Use T_O/TAC/T_D Switch (30) to set scope trigger output through SCOPE TRIG OUT Connector (AA). Set T_O/TAC/T_D Switch (30) to ***T_O*** for viewing interrogation from GEN Connector (15). Set T_O/TAC/T_D Switch (30) to ***T_D*** for viewing reply from XMTR Connector (12).

NOTE: Connect UUT XMTR Connector (C) to Oscilloscope for viewing UUT replies through ANT B Connector (E).

6. Verify UUT reply information as follows:

FREQUENCY

Verify UUT transmitting frequency with XMTR FREQ MHz Display (51).

ACCURACY

Set DISPLAY SELECT Control (40) to ***XPDR CODE*** setting. Verify reply content by viewing DISPLAY SELECT Readout (43). Select XPDR MODE Control (38) ***A*** setting to verify Mode A octal ID code. Select XPDR MODE Control (38) ***AC_2*** setting to verify Mode C altitude in feet. Reply pulses are displayed on Oscilloscope Channel 2.

REPLY DELAY

Reply delay, P_3 leading edge to F_1 leading edge, is shown in Control Menu #1 ***RpDly:*** field in microseconds. Verify reply delay is 3.0 µs (±0.5 µs).

SIGNAL DESCRIPTION

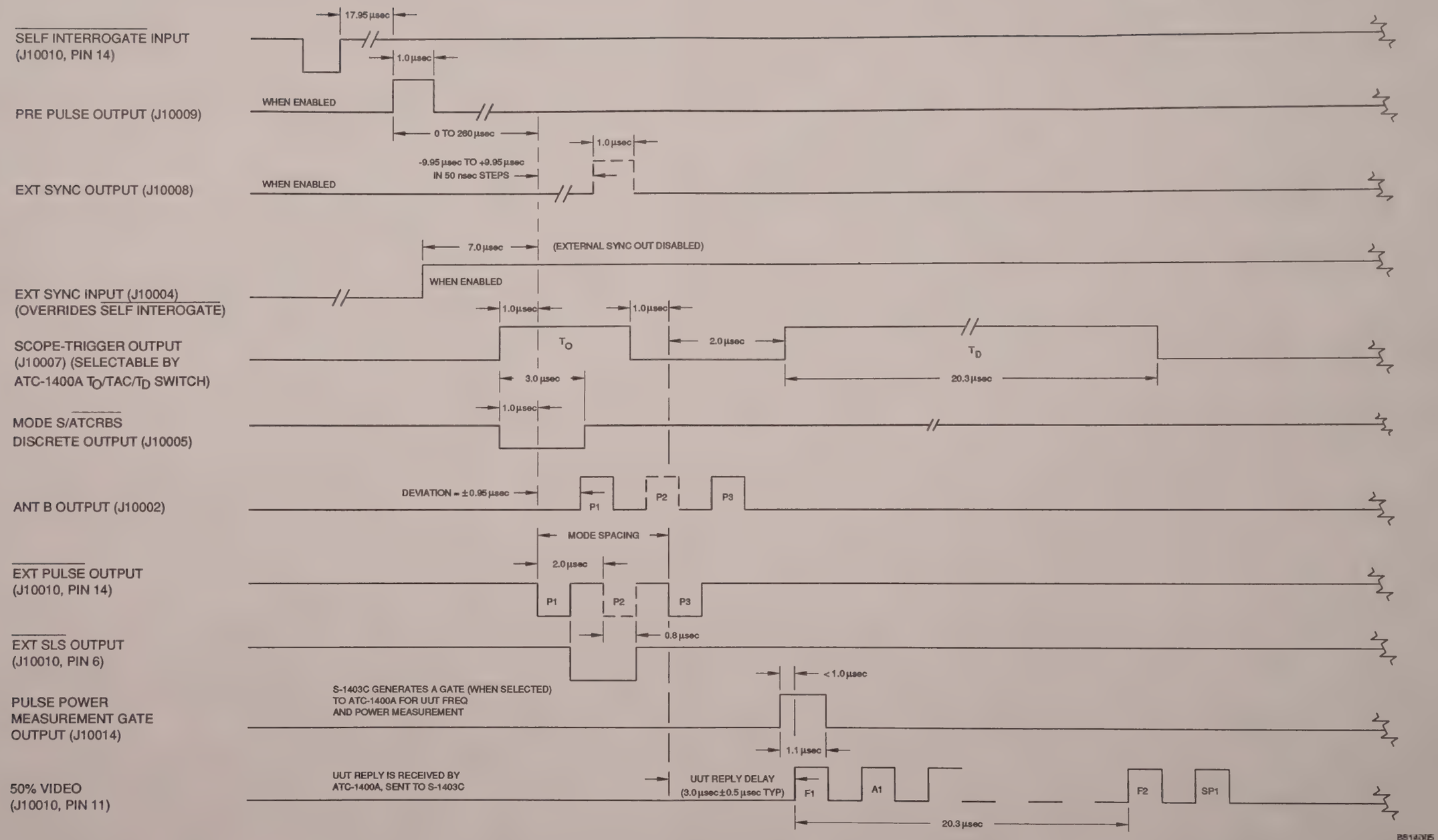
10. Pulse Power Measurement Gate Output

The pulse power measurement gate (PPMG) occurs <1.0 µs prior to leading edge of selected pulse and is transmitted to the ATC-1400A through the MEASUREMENT GATE OUT Connector (J10014) (HH).

NOTE: The ATC-1400A ignores PPMG if the F_2/P_2 F_1/P_1 Switch (34) is set to F_1/P_1.

11. 50% Video

The UUT reply video is received through ANT A, the ATC-1400A and the AUXILIARY Connector (J10010) (JJ).



ATC Test Function Timing Diagram
Figure 25

C. SEQ Test Function

(1) Description

In the SEQ Test Function, the Mode S Test System simulates a Mode S ground station transmitting standard three-pulse, DPSK modulated interrogations shown in Appendix F. Reply characteristics are measured to verify the Mode S transponder operates correctly.

(2) Procedure

STEP	PROCEDURE

1. Connect test equipment according to 1-2-4, Figure 24.

2. Apply power to Mode S Test System.

3. Verify Mode S Test System is not in any test function using sequence menus (***SEQ***; ***INTLCE***; ***DI,1st*** or ***2nd=SEQ*** or ***BURST,SEQ***). If necessary, use Keyboard (B) to select another test function.

4. Press S MENU Key to select sequence menu.

5. Refer to 1-2-2, Figure 16 and set Mode S interrogation sequence as follows:

SEQUENCE MENU

Program each of 16 sequence menus. On power up, Sequence Menus S01 through S08 are set to default and contain defined formats shown in Appendix B. Sequence Menus S09 through S16 are initially deactivated. With cursor under ***S***(sequence number) field, use SLEW Control (F) to enter each sequence menu. Press ON/CAL Key to activate or deactivate. Activate only desired sequence menus and deactivate all others.

FORMAT TYPE

Use SLEW Control (F) or ON/CAL Key to select format type for each active sequence menu. ***FMT D*** displays one of seven defined sequence menus depending on ***UF#*** field. ***FMT S*** displays unspecified short message field (9 octal digits) along with UUT address. ***FMT L*** displays unspecified long message field (28 octal digits) along with UUT address.

UPLINK FORMAT NUMBER

Move cursor to ***UF#*** field. Use SLEW Control (F) or Keyboard (B) to select desired uplink format number from ***00*** to ***31*** for unspecified short or long formats. Select UF00, UF04, UF05, UF11, UF16, UF20 or UF21 for defined formats.

STEP PROCEDURE

DATA FIELDS

Use Keyboard (B) to load data fields according to Appendix E. Refer to 1-2-5D for converting data to octal. Short message fields range from ***0*** to ***777777777***. Long message fields range from ***0*** to ***377777777777777 7777777777777***. Refer to Appendix B for defined fields.

UUT ADDRESS

Move cursor to ***ADD=*** field. Use Keyboard (B) to enter UUT address.

6. Select SEQ Test Function. Press 2ND, FUN NO and "2" Keys in sequence or move cursor to ***Func:*** field and press "2" Key.

7. Set test parameters as follows:

FREQUENCY

Adjust FREQ/FUNCTION Thumbwheels (45) and ΔF Thumbwheels (48) to set interrogation RF from ***952.01*** to ***1222.99*** MHz. Set to ***1030*** MHz for normal operation.

RF LEVEL

Adjust RF level from -130 to +3 dBm (-69 to -21 dBm is normal operating range) using RF LEVEL -dBm Display (3), RF LEVEL Control (6) and Control Menu #1 ***RFLvl:*** field. Adjust RF LEVEL Control (6) to set RF LEVEL -dBm Display (3) from ***127*** to ***0*** (-127 to 0 dBm). Press RF LVL Key to move cursor to Control Menu #1 ***RFLvl:*** field. Use Keyboard (B) or SLEW Control (F) to set ***RFLvl:*** field from ***-3.0*** to ***+3.0 dB*** to offset cable loss. Press ENT Key to enter selected value.

INTERROGATION RATE

Use PRF/SQTR Thumbwheels (41) to set interrogation rate or PRF from ***0*** to ***200***. Set from ***0*** to ***50*** for normal operation. Each activated sequence menu is one interrogation. PRF for entire sequence depends on number of activated sequence menus.

PULSE WIDTH

Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***CAL*** for 0.8 μs nominal width of P_1 and P_2 (if activated) interrogation pulses. Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***VAR*** and use XPDR PULSE WIDTH Thumbwheels (49) to adjust width from ***0.20*** to ***1.85*** μs.

STEP PROCEDURE

P_2 LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***OFF***. Press 2ND and P2 Keys in sequence to move cursor to Control Menu #1 ***P2:*** field. Press ON/CAL Key to set ***P2:VAR***. Set P_2 level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. 0 dB is normal operating level (***P2:CAL***). When P_2 deactivation is desired, press ON/CAL Key to set ***P2:*** field to ***OFF***.

P_2 POSITION

Set XPDR DEV P_2/CAL Switch (28) to ***CAL*** for nominal P_2 position of 2.0 µs following P_1 leading edge. Set XPDR DEV P_2/CAL Switch (28) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to set position from 0.15 to 3.85 µs following P_1 leading edge.

P_5 (SLS) LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***ON***. Set P_5 (SLS) level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. Verify suppression occurs when P_5 level exceeds P_6 level by 3 dB or more. Verify suppression does not occur when P_6 level exceeds P_5 level by 12 dB or more.

P_5 (SLS) POSITION

P_5 (SLS) position is centered on SPR. Adjusting SPR position changes P_5 position accordingly. Use SLEW Control (F) or Keyboard (B) to set Control Menu #1 ***SPR:,Dv=*** field from ***-1.00*** to ***+1.00*** (time deviated from nominal position in 0.05 µs increments).

P_6 CONTROL

Press 2ND and P4(P6) Keys in sequence to move cursor to Control Menu #1 ***P6:*** field. Press ON/CAL Key to deactivate or activate P_6 pulse.

P_6 WIDTH

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P6:,Wd=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.50*** to ***+1.50*** (time deviated from nominal widths in 0.05 µs increments). Nominal widths are 16.25 µs for 56-bit data field and 30.25 µs for 112-bit data field (Control Menu #1 ***P6:,Wd= CAL***).

P_6 POSITION

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P6:,Dv=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to select variable value from ***-1.95*** to ***+1.95*** (time deviated from nominal position in 0.05 µs increments). Nominal position is 3.5 µs following P_1 leading edge (control Menu #1 ***P6:,Dv= CAL***).

STEP PROCEDURE

SPR CONTROL

Press 2ND and SPR Keys in sequence to move cursor to Control Menu #1 ***SPR:*** field. Press ON/CAL Key to deactivate or activate SPR.

SPR POSITION

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***SPR:,Dv=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.00*** to ***+1.00*** (time deviated from nominal position in 0.05 µs increments). Nominal position is 1.25 µs following P_6 leading edge (Control Menu #1 ***SPR:,Dv= CAL***).

INTERFERENCE PULSE

Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+***. Interference pulse is activated and positioned at -17.5 to +399.0 µs from leading edge of P_1. Set level from ***-19*** to ***+6*** dB (relative to P_1) using SLS/ECHO Thumbwheels (50). Set width from 0.2 to 5 µs using INTRF PULSE WIDTH Control (31).

SUPPRESSOR PULSE

Connect SUPPRESSOR OUTPUT Connector (16) to UUT suppressor input. Set SUPPRESSOR ON/OFF Switch (17) to ***ON*** to activate suppressor pulse. Adjust level from 3 to 27 V using SUPPRESSOR VAR Adjustment (19). When DBL INTERR/INTRF PULSE Thumbwheels (42) are ***OFF***, suppressor pulse position is 0.8 µs prior to SPR. Activate interference pulse to control position of suppressor pulse (suppressor pulse replaces interference pulse when both are activated). Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+*** to adjust suppressor pulse position from -17.5 to +399.0 µs relative to P_1. Width is fixed at 33 µs.

ANT B

Press 2ND and ANT B Keys in sequence to move cursor to Control Menu #1 ***AntB:*** field. Press ON/CAL Key to activate interrogations through ANT B Connector (E). Use SLEW Control (F) or Keyboard (B) to enter value from ***-0.95*** to ***+0.95*** (offset in 0.05 µs increments from ANT A interrogations).

If Multi-Level Diversity option is installed, set ANT B output level. Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Brf=*** and ***Brflvl=*** fields. Using SLEW Control (F) or Keyboard (B), set ***Brf=*** field from ***-80*** to ***-20 dBm*** and ***Brflvl=*** field from ***-3.0*** to ***+3.0 dB*** (used to offset cable loss).

STEP PROCEDURE

8. If desired, set optional inputs and outputs as follows:

PREPULSE

Press 2ND and P PULS Keys in sequence to move cursor to Control Menu #2 ***Prepulse:*** field. Press ON/CAL Key to activate prepulse through PREPULSE OUT Connector (EE). Use SLEW Control (F) or Keyboard (B) to enter value from ***0*** to ***260*** (time in microseconds from prepulse leading edge to P_1 leading edge).

NOTE: Prepulse does not operate as specified when activated at the same time as external sync input.

EXT SYNC OUTPUT

Press 2ND and EXT SYN Keys in sequence to move cursor to Control Menu #2 ***Ext.Sync.:Out=*** subfield. Press ON/CAL Key to activate external sync pulse through EXT SYNC OUT Connector (CC). Use SLEW Control (F) or Keyboard (B) to set ***Ext.Sync.:,Dv=*** subfield value from ***-9.95*** to ***+9.95*** (time in microseconds from external sync pulse leading edge to P_1 leading edge) (**-**, P_1 follows external sync; **+**, external sync follows P_1).

EXT SYNC INPUT

Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Ext.Sync.:,In=*** subfield. Press ON/CAL Key to set EXT SYNC IN Connector (BB) for external sync pulse input. Leading edge of P_1 occurs 7.0 µs after leading edge of external sync pulse. When external sync input is activated, external sync output is deactivated and associated subfields are blank. External sync input controls PRF and is limited same as internal PRF control.

SCOPE TRIGGER OUTPUT

Use T_O/TAC/T_D Switch (30) to set scope trigger output through SCOPE TRIG OUT Connector (AA). Set T_O/TAC/T_D Switch (30) to ***T_O*** for viewing interrogation from GEN Connector (15). Set T_O/TAC/T_D Switch (30) to ***T_D*** for viewing reply from XMTR Connector (12).

NOTE: Connect UUT XMTR Connector (C) to Oscilloscope for viewing UUT replies through ANT B Connector (E).

9. Verify UUT reply information as follows:

FREQUENCY

Verify UUT transmitting frequency with XMTR FREQ MHz Display (51).

REPLY DELAY

Reply delay, SPR to P_1 leading edge in reply, is shown in Control Menu #1 ***RpDly:*** field in microseconds. Verify reply delay is 128 µs (±0.5 µs).

STEP PROCEDURE

PERCENT REPLY

Verify percent reply shown in Control Menu #1 ***%Reply:*** subfields. ***%Reply:S=*** subfield displays percent reply for ANT A. ***%Reply:AntB=*** subfield displays percent reply for ANT B. Verify ***%Reply:ATC= Ø***. If Multi-Level Diversity option is installed, ANT B percent reply is also displayed in Control Menu #2 ***AntB%=*** field.

NOTE: Only the Mode S preamble is detected (squitter excluded) for calculating Mode S percent reply.

POWER

Verify UUT power through RF I/O Connector (9) shown on XMTR PWR WATTS Display (1). Set F_2/P_2 F_1/P_1 Switch (34) to ***F_1/P_1*** to measure pulse power of P_1 reply pulse only. Set F_2/P_2 F_1/P_1 Switch (34) to ***F_2/P_2*** for S-1403C to have control over pulse power measurement selection.

Select reply pulse to be measured by setting ***Pulse Power Gate:*** field. Press 2ND and PPG Keys in sequence. Use SLEW Control (F) or Keyboard (B) to select one of 116 possible Mode S reply pulses. For short message fields, only ***1*** to ***60*** is valid.

Measurement gate is enabled prior to rising edge of pulse to be measured. Measurement continues until next falling edge of reply. Mode S replies are pulse position modulated and adjacent pulses cause erroneous power readings during following conditions:

- If measurement pulse data is "0" and following pulse data is "1", measurement pulse (selected) and following pulse are measured together because following pulse has first detectable falling edge.

- If measurement pulse data is "1" and preceding pulse data is "0", power reading is zero because no rising edge is detected.

ACCURACY

Press S MENU Key to select sequence menu. Verify downlink format data fields are in accordance with Appendix E and correspond to uplink format data programmed for each active sequence menu. Refer to 1-2-5D for converting octal data to binary. Reply pulses are displayed on Oscilloscope Channel 2.

10. Verify UUT Mode S squitter information as follows:

INTERVAL

Verify interval between squitters shown in Control Menu #1 ***Sqtr:*** field in seconds. Normal squitter intervals range from 0.8 to 1.2 seconds.

STEP PROCEDURE

ADDRESS

Verify squitter address shown in Control Menu #2 ***Sqtr. Add.*** field. 24-bit address from DF11 is shown as 8 octal digits.

(3) General Test Sequence (Refer to 1-2-4, Figure 26.)

SIGNAL DESCRIPTION

1. $\overline{\text{Self Interrogate}}$ Input

   Active low pulse from the ATC-1400A triggers the interrogation process unless an external sync input is activated. The self interrogate pulse rising edge occurs 17.95 µs prior to P_1 leading edge or prepulse leading edge (when enabled). The self interrogate pulse is received through the AUXILIARY Connector (J10010) (JJ).

2. Prepulse Output (when enabled)

   Active high pulse, 1.0 µs wide, occurs 0 to 260 µs prior to P_1 leading edge as selected and is transmitted through the PREPULSE OUT Connector (J10009) (EE).

3. Ext Sync Output (when enabled)

   Active high pulse, 1.0 µs wide, occurs from 9.95 µs prior to P_1 leading edge to 9.95 µs following P_1 leading edge as selected and is transmitted through the EXT SYNC OUT Connector (J10008) (CC).

4. Ext Sync Input (when enabled)

   Active high pulse occurs 7.0 µs prior to P_1 leading edge and is received through the EXT SYNC IN Connector (J10004) (BB). The external sync input replaces self interrogate input in triggering interrogation process.

5. Scope Trigger Output

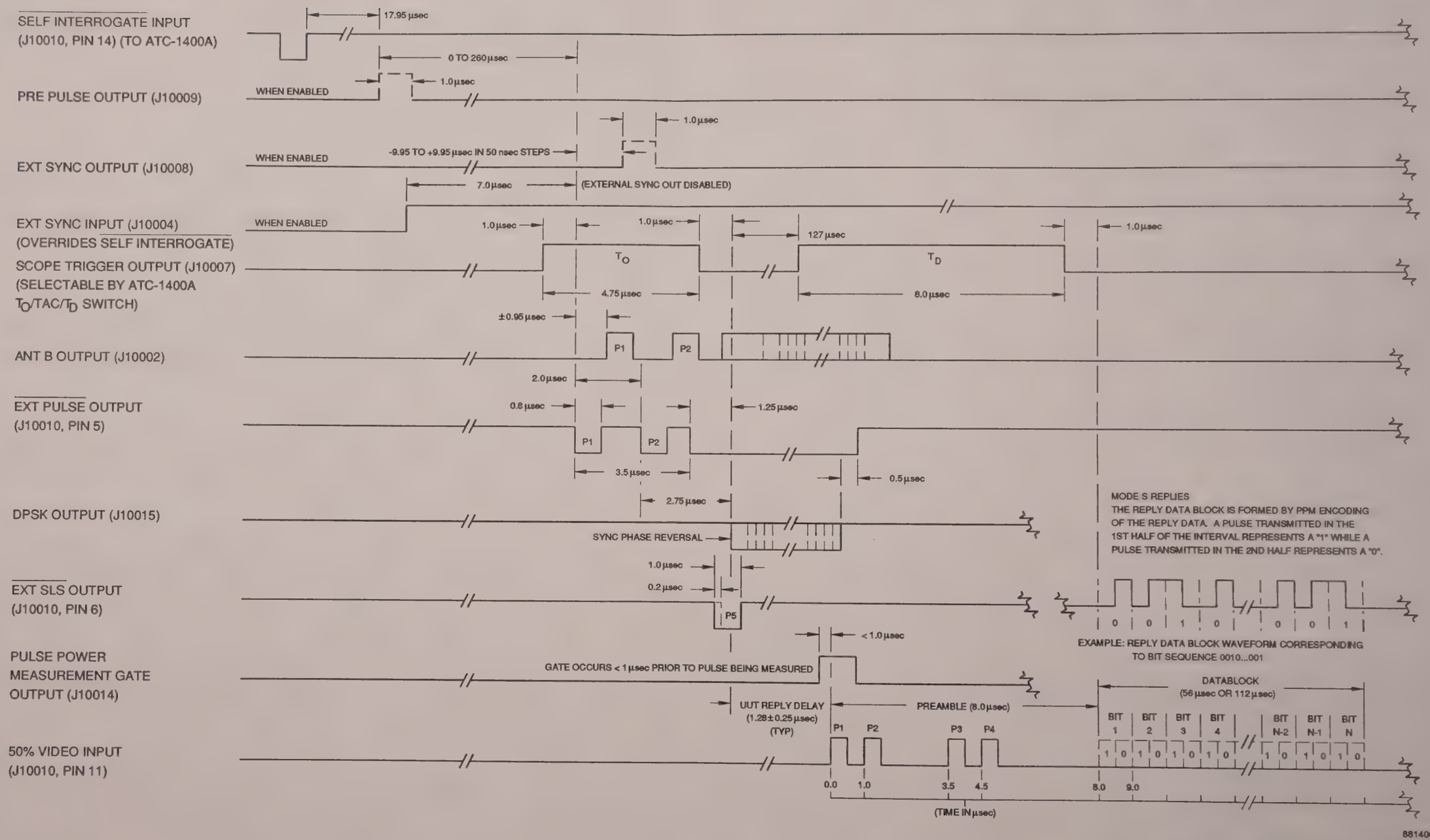
   Scope trigger is transmitted through the SCOPE TRIG OUT Connector (J10007) (AA) and depends on the T_O/TAC/T_D Switch (30) setting:

   ***T_O* POSITION** (for viewing interrogations)

   Active high pulse, 4.75 µs wide, occurs from 1.0 µs prior to P_1 leading edge to 1.0 µs prior to P_3 leading edge.

   ***T_D* POSITION** (for viewing replies)

   Active high pulse, 8.0 µs wide, occurs 127 µs following SPR.



SEQ Test Function Timing Diagram
Figure 26

SIGNAL DESCRIPTION

6. ANT B Output (when enabled)

   Active high ANT B interrogation pulses and DPSK data modulate RF transmitted through the ANT B Connector (J10002) (E). P_1 leading edge of ANT B interrogation is offset from P_1 leading edge of ANT A interrogation as selected in Control Menu #1 ***AntB:*** field, in microseconds. ANT B and ANT A characteristics are the same except for pulse level.

7. $\overline{\text{Ext Pulse}}$ Output

   Active low pulses transmitted through the AUXILIARY Connector (J10010) (JJ) to modulate ATC-1400A RF output. Pulse characteristics vary according to test parameter settings. Refer to 1-2-4C(2).

8. DPSK Output

   The DPSK output contains the uplink format data information used to modulate the ANT A interrogation signal. The data constantly changes when more than one uplink format is being sent in an interrogation sequence. The first synchronous phase reversal (SPR) occurs 1.25 µs following P_6 leading edge and is transmitted through the DPSK OUT Connector (J10015) (II) to the ATC-1400A.

9. $\overline{\text{Ext SLS}}$ Output (when enabled)

   Active low gate pulse enables SLS/ECHO Thumbwheels (50) to control the level of P_5 (SLS) or P_2 depending on SLS/ECHO ON/OFF Switch (18) position and Control Menu #1 ***P2:*** field setting.

10. Pulse Power Measurement Gate Output

    The pulse power measurement gate (PPMG) occurs <1.0 µs prior to leading edge of selected pulse and is transmitted to the ATC-1400A through the MEASUREMENT GATE OUT Connector (J10014) (HH).

    NOTE: The ATC-1400A ignores PPMG if the F_2/P_2 F_1/P_1 Switch (34) is set to ***F_1/P_1***.

11. 50% Video

    The UUT reply video is received through ANT A, the ATC-1400A and the AUXILIARY Connector (J10010) (JJ).

D. ACS Test Function

(1) Description

In the ACS Test Function, the Mode S Test System transmits ATCRBS Only All-Call interrogations shown in Appendix F. The ACS Test Function is used to verify Mode S transponders do not reply and ATCRBS only transponders reply correctly.

(2) Procedure

STEP	PROCEDURE

1. Connect test equipment according to 1-2-4, Figure 24.

2. Apply power to Mode S Test System.

3. Select ACS Test Function. Press 2ND, FUN NO and "3" Keys in sequence or move cursor to ***Func:*** field and press "3" Key.

4. Set test parameters as follows:

MODE SELECTION

Use XPDR MODE Control (38) to select P_1 to P_3 pulse spacing. Select interrogation mode (***1***, ***2***, ***T***, ***A***, ***B***, ***C*** or ***D***). Select ***AC_2*** for Mode C interrogations when the decoded reply in feet is desired on the DISPLAY SELECT Readout (43). ***AC_1*** is not used.

FREQUENCY

Adjust FREQ/FUNCTION Thumbwheels (45) and ΔF Thumbwheels (48) to set interrogation RF from ***952.01*** to ***1222.99*** MHz. Set to ***1030*** MHz for normal operation.

RF LEVEL

Adjust RF level from -130 to +3 dBm (-69 to -21 dBm is normal operating range) using RF LEVEL -dBm Display (3), RF LEVEL Control (6) and Control Menu #1 ***RFLvl:*** field. Adjust RF LEVEL Control (6) to set RF LEVEL -dBm Display (3) from ***127*** to ***0*** (-127 to 0 dBm). Press RF LVL Key to move cursor to Control Menu #1 ***RFLvl:*** field. Use Keyboard (B) or SLEW Control (F) to set ***RFLvl:*** field from ***-3.0*** to ***+3.0 dB*** to offset cable loss. Press ENT Key to enter selected value.

INTERROGATION RATE

Adjust PRF/SQTR Thumbwheels (41) to set interrogation rate or PRF from ***0*** to ***2400***. Set from ***0*** to ***500*** for normal operation.

STEP PROCEDURE

PULSE WIDTH

Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***CAL*** for 0.8 µs nominal width of P_1, P_2 (SLS) (if activated) and P_3 (if activated) interrogation pulses. Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***VAR*** and use XPDR PULSE WIDTH Thumbwheels (49) to adjust width from ***0.20*** to ***1.85*** µs.

P_2 (SLS) LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***ON***. Set P_2 (SLS) level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. Verify suppression occurs when P_2 level equals or exceeds P_1 level. Verify suppression does not occur when P_1 level exceeds P_2 level by 9 dB or more.

P_2 (SLS) POSITION

Set XPDR DEV P_2/CAL Switch (28) to ***CAL*** for nominal P_2 (SLS) position of 2.0 µs following P_1 leading edge. Set XPDR DEV P_2/CAL Switch (28) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to set position from 0.15 to 3.85 µs following P_1 leading edge.

P_3 LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***OFF***. Press 2ND and P3 Keys in sequence to move cursor to Control Menu #1 ***P3:*** field. Press ON/CAL Key to set ***P3:VAR***. Set P_3 level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. 0 dB is normal operating level (***P3:CAL***). When P_3 deactivation is desired, press ON/CAL Key to set ***P3:OFF***.

P_3 POSITION

Set XPDR DEV P_3/CAL Switch (25) to ***CAL*** for nominal P_3 position. Refer to Appendix F for nominal position. Set XPDR DEV P_3/CAL Switch (25) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to deviate position -1.85 to +1.85 µs from normal.

P_4 LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***OFF***. Press 2ND and P4(P6) Keys in sequence to move cursor to Control Menu #1 ***P4:*** field. Press ON/CAL Key to set ***P4:VAR***. Set P_4 level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. 0 dB is normal operating level (***P4:CAL***). When P_4 deactivation is desired, press ON/CAL Key to set ***P4:OFF***.

STEP PROCEDURE

P_4 WIDTH

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P4:,Wd=*** subfield. ***P4:,Wd= CAL*** sets nominal P_4 width at 0.8 µs. P_4 width is adjustable from 0.2 to 2.75 µs. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-0.60*** to ***+1.95*** (time deviated from 0.8 µs in 0.05 µs increments).

NOTE: When P_4 is set wider than 1.5 µs, ATCRBS Only All-Call becomes ATCRBS/Mode S All-Call. Keep P_4 width <1.2 µs for ATCRBS Only All-Call interrogations.

P_4 POSITION

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P4:,Dv=*** subfield. ***P4:,Dv= CAL*** sets nominal P_4 position at 2.0 µs following leading edge of P_3. P_4 position is adjustable from 0.05 to 3.95 µs following leading edge of P_3. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.95*** to ***+1.95*** (time deviated from 2.0 µs in 0.05 µs increments).

INTERFERENCE PULSE

Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+***. Interference pulse is activated and positioned at -17.5 to +399.0 µs from leading edge of P_1. Set level from ***-19*** to ***+6*** dB (relative to P_1) using SLS/ECHO Thumbwheels (50). Set width from 0.2 to 5 µs using INTRF PULSE WIDTH Control (31).

SUPPRESSOR PULSE

Connect SUPPRESSOR OUTPUT Connector (16) to UUT suppressor input. Set SUPPRESSOR ON/OFF Switch (17) to ***ON*** to activate suppressor pulse. Adjust level from 3 to 27 V using SUPPRESSOR VAR Adjustment (19). When DBL INTERR/INTRF PULSE Thumbwheels (42) are ***OFF***, suppressor pulse position is 0.8 µs prior to SPR. Activate interference pulse to control position of suppressor pulse (suppressor pulse replaces interference pulse when both are activated). Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+*** to adjust suppressor pulse position from -17.5 to +399.0 µs relative to P_1. Width is fixed at 33 µs.

STEP PROCEDURE

ANT B

Press 2ND and ANT B Keys in sequence to move cursor to Control Menu #1 ***AntB:*** field. Press ON/CAL Key to activate interrogations through ANT B Connector (E). Use SLEW Control (F) or Keyboard (B) to enter value from ***-0.95*** to ***+0.95*** (offset in 0.05 µs increments from ANT A interrogations).

If Multi-Level Diversity option is installed, set ANT B output level. Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Brf=*** and ***BrfIvl=*** fields. Using SLEW Control (F) or Keyboard (B), set ***Brf=*** field from ***-80*** to ***-20 dBm*** and ***BrfIvl=*** field from ***-3.0*** to ***+3.0 dB*** (used to offset cable loss).

5. If desired, set optional inputs and outputs as follows:

PREPULSE

Press 2ND and P PULS Keys in sequence to move cursor to Control Menu #2 ***Prepulse:*** field. Press ON/CAL Key to activate prepulse through PREPULSE OUT Connector (EE). Use SLEW Control (F) or Keyboard (B) to enter value from ***0*** to ***260*** (time in microseconds from prepulse leading edge to P_1 leading edge).

NOTE: Prepulse does not operate as specified when activated at the same time as external sync input.

EXT SYNC OUTPUT

Press 2ND and EXT SYN Keys in sequence to move cursor to Control Menu #2 ***Ext.Sync.:Out=*** subfield. Press ON/CAL Key to activate external sync pulse through EXT SYNC OUT Connector (CC). Use SLEW Control (F) or Keyboard (B) to set ***Ext.Sync.:,Dv=*** subfield value from ***-9.95*** to ***+9.95*** (time in microseconds from external sync pulse leading edge to P_1 leading edge) (**-**, P_1 follows external sync; **+**, external sync follows P_1).

EXT SYNC INPUT

Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Ext.Sync.:,In=*** subfield. Press ON/CAL Key to set EXT SYNC IN Connector (BB) for external sync pulse input. Leading edge of P_1 occurs 7.0 µs after leading edge of external sync pulse. When external sync input is activated, external sync output is deactivated and associated subfields are blank. External sync input controls PRF and is limited same as internal PRF control.

EXT MODULATION INPUT

Press 2ND and EX MOD Keys in sequence to move cursor to Control Menu #2 ***Ext.Mod.In:*** field. Press ON/CAL Key to set ***Ext.Mod.In: ON***. Internal pulse modulation is deactivated. Interrogation is modulated by external modulation input through EXT MOD IN Connector (Z).

SCOPE TRIGGER OUTPUT

Use T_O/TAC/T_D Switch (30) to set scope trigger output through SCOPE TRIG OUT Connector (AA). Set T_O/TAC/T_D Switch (30) to ***T_O*** for viewing interrogation from GEN Connector (15). Set T_O/TAC/T_D Switch (30) to ***T_D*** for viewing reply from XMTR Connector (12).

NOTE: Connect UUT XMTR Connector (C) to Oscilloscope for viewing UUT replies through ANT B Connector (E).

6. Verify UUT reply information as follows:

Verify ATCRBS only transponders reply to normal interrogations without suppression. Verify Mode S transponders do not reply.

FREQUENCY

Verify UUT transmitting frequency with XMTR FREQ MHz Display (51).

ACCURACY

Set DISPLAY SELECT Control (40) to ***XPDR CODE*** setting. Verify ATCRBS reply content by viewing DISPLAY SELECT Readout (43). Select XPDR MODE Control (38) ***A*** setting to verify Mode A octal ID code. Select XPDR MODE Control (38) ***AC_2*** setting to verify Mode C altitude in feet. Reply pulses are displayed on Oscilloscope Channel 2.

REPLY DELAY

Reply delay depends on type of reply received and is shown in Control Menu #1 ***RpDly:*** field in microseconds. Verify ATCRBS reply delay, P_3 leading edge to F_1 leading edge, is 3.0 µs (±0.5 µs). Mode S replies are measured from P_4 leading edge to P_1 leading edge in reply.

PERCENT REPLY

Verify percent reply shown in Control Menu #1 ***%Reply:*** subfields. ***%Reply:ATC=*** subfield displays percent reply for ATCRBS through ANT A. ***%Reply:S=*** subfield displays percent reply for Mode S through ANT A. ***%Reply:AntB=*** subfield displays percent reply for ATCRBS and Mode S through ANT B. If Multi-Level Diversity option is installed, ANT B percent reply is also displayed in Control Menu #2 ***AntB%=*** field.

STEP PROCEDURE

POWER

Verify UUT power through ANT A (RF I/O Connector (9) shown on XMTR PWR WATTS Display (1). Set F_2/P_2 F_1/P_1 Switch (34) to ***F_1/P_1*** to measure pulse power of F_1 or P_1 reply pulse only. Set F_2/P_2 F_1/P_1 Switch (34) to ***F_2/P_2*** for S-1403C to have control over pulse power measurement selection.

Select reply pulse to be measured by setting ***Pulse Power Gate:*** field. Press 2ND and PPG Keys in sequence. Use SLEW Control (F) or Keyboard (B) to select one of 16 possible ATCRBS reply pulses (displayed as ***P f1*** through ***P f2***). When Mode S replies are received, use SLEW Control (F) or Keyboard (B) to select one of 116 possible Mode S reply pulses.

Measurement gate is enabled prior to rising edge of pulse to be measured. Measurement continues until next falling edge of reply. Mode S replies are pulse position modulated and adjacent pulses cause erroneous power readings during following conditions:

- If measurement pulse data is "0" and following pulse data is "1", measurement pulse (selected) and following pulse are measured together because following pulse has first detectable falling edge.
- If measurement pulse data is "1" and preceding pulse data is "0", power reading is zero because no rising edge is detected.

7. Verify UUT Mode S squitter information as follows:

INTERVAL

Verify interval between squitters shown in Control Menu #1 ***Sqtr:*** field in seconds. Normal squitter intervals range from 0.8 to 1.2 seconds.

ADDRESS

Verify squitter address shown in Control Menu #2 ***Sqtr. Add.*** field. 24-bit address from DF11 is shown as 8 octal digits.

(3) General Test Sequence (Refer to 1-2-4, Figure 27.)

SIGNAL DESCRIPTION

1. $\overline{\text{Self Interrogate}}$ Input

Active low pulse from the ATC-1400A triggers the interrogation process unless an external sync input is activated. The self interrogate pulse rising edge occurs 17.95 µs prior to P_1 leading edge or prepulse leading edge (when enabled). The self interrogate pulse is received through the AUXILIARY Connector (J10010) (JJ).

SIGNAL DESCRIPTION

2. Prepulse Output (when enabled)

   Active high pulse, 1.0 µs wide, occurs 0 to 260 µs prior to P_1 leading edge as selected and is transmitted through the PREPULSE OUT Connector (J10009) (EE).

3. Ext Sync Output (when enabled)

   Active high pulse, 1.0 µs wide, occurs from 9.95 µs prior to P_1 leading edge to 9.95 µs following P_1 leading edge as selected and is transmitted through the EXT SYNC OUT Connector (J10008) (CC).

4. Ext Sync Input (when enabled)

   Active high pulse occurs 7.0 µs prior to P_1 leading edge and is received through the EXT SYNC IN Connector (J10004) (BB). The external sync input replaces the self interrogate input in triggering the interrogation process.

5. Scope Trigger Output

   Scope trigger is transmitted through the SCOPE TRIG OUT Connector (J10007) (AA) and depends on the T_O/TAC/T_D Switch (30) setting:

   ***T_O* POSITION** (for viewing interrogations)

   Active high pulse occurs from 1.0 µs prior to P_1 leading edge to 1.0 µs prior to P_4 leading edge.

   ***T_D* POSITION** (for viewing replies)

   Active high pulse, 8.0 µs wide, occurs 1.0 µs prior to F_1 or P_1 leading edge of the reply.

6. Mode S/$\overline{\text{ATCRBS}}$ Discrete Output

   Active low pulse, 3.0 µs wide, occurs 1.0 µs prior to P_1 leading edge and is transmitted through the MODE S/ATCRBS DISCRETE OUT Connector (J10005) (DD).

7. ANT B Output (when enabled)

   Active high ANT B interrogation pulses modulate RF transmitted through ANT B Connector (J10002) (E). P_1 leading edge of ANT B interrogation is offset from P_1 leading edge of ANT A interrogation as selected in Control Menu #1 ***AntB:*** field, in microseconds. ANT B and ANT A pulse characteristics are the same except for pulse level.

SIGNAL DESCRIPTION

8. $\overline{\text{Ext Pulse}}$ Output

   Active low pulses transmitted through the AUXILIARY Connector (J10010) (JJ) modulate ATC-1400A RF output. Pulse characteristics vary according to test parameter settings. Refer to 1-2-4D(2).

9. $\overline{\text{Ext SLS}}$ Output (when enabled)

   Active low gate pulse enables SLS/ECHO Thumbwheels (50) to control the level of P_2 (SLS) or other applicable interrogation pulses (P_3 and P_4) depending on SLS/ECHO ON/OFF Switch (18) position and Control Menu #1 pulse field settings.

10. Pulse Power Measurement Gate Output

    The pulse power measurement gate (PPMG) occurs <1.0 µs prior to leading edge of selected pulse and is transmitted to the ATC-1400A through the MEASUREMENT GATE OUT Connector (J10014) (HH).

    NOTE: The ATC-1400A ignores PPMG if the F_2/P_2 F_1/P_1 Switch (34) is set to ***F_1/P_1***.

11. 50% Video

    The UUT reply video is received through ANT A, the ATC-1400A and the AUXILIARY Connector (J10010) (JJ) (only with an ATCRBS only transponder). When the ACS Test Function is operating with no pulse adjustments, no reply video is expected from Mode S transponders.

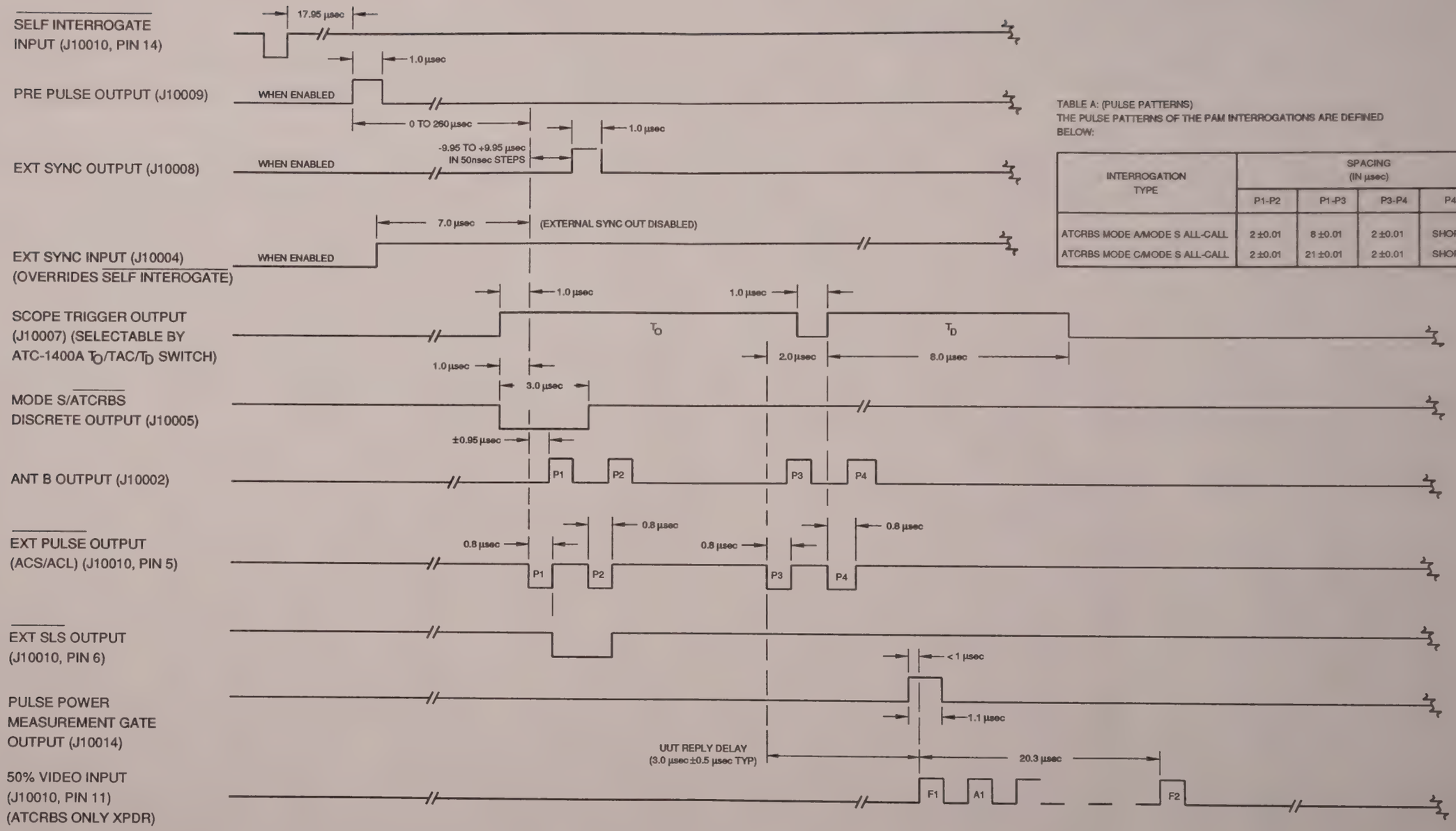


TABLE A: (PULSE PATTERNS)
THE PULSE PATTERNS OF THE PAM INTERROGATIONS ARE DEFINED BELOW:

INTERROGATION TYPE	SPACING (IN µsec)			
	P1-P2	P1-P3	P3-P4	P4
ATCRBS MODE A/MODE S ALL-CALL	2 ±0.01	8 ±0.01	2 ±0.01	SHORT
ATCRBS MODE C/MODE S ALL-CALL	2 ±0.01	21 ±0.01	2 ±0.01	SHORT

8814010

ACS Test Function Timing Diagram
Figure 27

E. ACL Test Function

(1) Description

In the ACL Test Function, the Mode S Test System transmits ATCRBS/Mode S All-Call interrogations shown in Appendix F. Reply characteristics are measured to verify ATCRBS and Mode S transponders operate correctly.

(2) Procedure

STEP	PROCEDURE

1. Connect test equipment according to 1-2-4, Figure 24.

2. Apply power to Mode S Test System.

3. Select ACL Test Function. Press 2ND, FUN NO and "4" Keys in sequence or move cursor to ***Func:*** field and press "4" Key.

4. Set test parameters as follows:

MODE SELECTION

Use XPDR MODE Control (38) to select P_1 to P_3 pulse spacing. Select interrogation mode (***1***, ***2***, ***T***, ***A***, ***B***, ***C*** or ***D***).

FREQUENCY

Use FREQ/FUNCTION Thumbwheels (45) and ΔF Thumbwheels (48) to set interrogation RF from ***952.01*** to ***1222.99*** MHz. Set to ***1030*** MHz for normal operation.

RF LEVEL

Adjust RF level from -130 to +3 dBm (-69 to -21 dBm is normal operating range) using RF LEVEL -dBm Display (3), RF LEVEL Control (6) and Control Menu #1 ***RFLvl:*** field. Adjust RF LEVEL Control (6) to set RF LEVEL -dBm Display (3) from ***127*** to ***0*** (-127 to 0 dBm). Press RF LVL Key to move cursor to Control Menu #1 ***RFLvl:*** field. Use Keyboard (B) or SLEW Control (F) to set ***RFLvl:*** field from ***-3.0*** to ***+3.0*** dB to offset cable loss. Press ENT Key to enter selected value.

INTERROGATION RATE

Use PRF/SQTR Thumbwheels (41) to set interrogation rate or PRF from ***0*** to ***200***.

PULSE WIDTH

Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***CAL*** for 0.8 μs nominal width of P_1, P_2 (SLS) (if activated) and P_3 (if activated) interrogation pulses. Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***VAR*** and use XPDR PULSE WIDTH Thumbwheels (49) to adjust width from ***0.20*** to ***1.85*** μs .

STEP PROCEDURE

P_2 (SLS) LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***ON***. Set P_2 (SLS) level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. Verify suppression occurs when P_2 level equals or exceeds P_1 level. Verify suppression does not occur when P_1 level exceeds P_2 level by 9 dB or more.

P_2 (SLS) POSITION

Set XPDR DEV P_2/CAL Switch (28) to ***CAL*** for nominal P_2 (SLS) position of 2.0 µs following P_1 leading edge. Set XPDR DEV P_2/CAL Switch (28) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to set position from 0.15 to 3.85 µs following P_1 leading edge.

P_3 LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***OFF***. Press 2ND and P3 Keys in sequence to move cursor to Control Menu #1 ***P3:*** field. Press ON/CAL Key to set ***P3:VAR***. Set P_3 level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. 0 dB is normal operating level (***P3:CAL***). When P_3 deactivation is desired, press ON/CAL Key to set ***P3:OFF***.

P_3 POSITION

Set XPDR DEV P_3/CAL Switch (25) to ***CAL*** for nominal P_3 position. Refer to Appendix F for nominal position. Set XPDR DEV P_3/CAL Switch (25) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to deviate position -1.85 to +1.85 µs from nominal.

P_4 LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***OFF***. Press 2ND and P4(P6) Keys in sequence to move cursor to Control Menu #1 ***P4:*** field. Press ON/CAL Key to set ***P4:VAR***. Set P_4 level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. 0 dB is normal operating level (***P4:CAL***). When P_4 deactivation is desired, press ON/CAL Key to set ***P4:OFF***.

P_4 WIDTH

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P4:,Wd=*** subfield. ***P4:,Wd= CAL*** sets nominal P_4 width at 1.6 µs. P_4 width is adjustable from 0.2 to 3.55 µs. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.40*** to ***+1.95*** (time deviated from 1.6 µs in 0.05 µs increments).

NOTE: When P_4 is set narrower than 1.2 µs, ATCRBS/Mode S All-Call becomes ATCRBS Only All-Call. Keep P_4 width >1.5 µs for ATCRBS/Mode S All-Call interrogations.

P_4 POSITION

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P4:,Dv=*** subfield. ***P4:,Dv= CAL*** sets nominal P_4 position at 2.0 µs following leading edge of P_3. P_4 position is adjustable from 0.05 to 3.95 µs following leading edge of P_3. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.95*** to ***+1.95*** (time deviated from 2.0 µs in 0.05 µs increments).

INTERFERENCE PULSE

Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+***. Interference pulse is activated and positioned at -17.5 to +399.0 µs from leading edge of P_1. Set level from ***-19*** to ***+6*** dB (relative to P_1) using SLS/ECHO Thumbwheels (50). Set width from 0.2 to 5 µs using INTRF PULSE WIDTH Control (31).

SUPPRESSOR PULSE

Connect SUPPRESSOR OUTPUT Connector (16) to UUT suppressor input. Set SUPPRESSOR ON/OFF Switch (17) to ***ON*** to activate suppressor pulse. Adjust level from 3 to 27 V using SUPPRESSOR VAR Adjustment (19). When DBL INTERR/INTRF PULSE Thumbwheels (42) are ***OFF***, suppressor pulse position is 0.8 µs prior to SPR. Activate interference pulse to control position of suppressor pulse (suppressor pulse replaces interference pulse when both are activated). Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+*** to adjust suppressor pulse position from -17.5 to +399.0 µs relative to P_1. Width is fixed at 33 µs.

ANT B

Press 2ND and ANT B Keys in sequence to move cursor to Control Menu #1 ***AntB:*** field. Press ON/CAL Key to activate interrogations through ANT B Connector (E). Use SLEW Control (F) or Keyboard (B) to enter value from ***-0.95*** to ***+0.95*** (offset in 0.05 µs increments from ANT A interrogations).

If Multi-Level Diversity option is installed, set ANT B output level. Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Brf=*** and ***BrfIvl=*** fields. Using SLEW Control (F) or Keyboard (B), set ***Brf=*** field from ***-80*** to ***-20 dBm*** and ***BrfIvl=*** field from ***-3.0*** to ***+3.0 dB*** (used to offset cable loss).

5. If desired, set optional inputs and outputs as follows:

PREPULSE

Press 2ND and P PULS Keys in sequence to move cursor to Control Menu #2 ***Prepulse:*** field. Press ON/CAL Key to activate prepulse through PREPULSE OUT Connector (EE). Use SLEW Control (F) or Keyboard (B) to enter value from ***0*** to ***260*** (time in microseconds from prepulse leading edge to P_1 leading edge).

NOTE: Prepulse does not operate as specified when activated at the same time as external sync input.

EXT SYNC OUTPUT

Press 2ND and EXT SYN Keys in sequence to move cursor to Control Menu #2 ***Ext.Sync.:Out=*** subfield. Press ON/CAL Key to activate external sync pulse through EXT SYNC OUT Connector (CC). Use SLEW Control (F) or Keyboard (B) to set ***Ext.Sync.:,Dv=*** subfield value from ***-9.95*** to ***+9.95*** (time in microseconds from external sync pulse leading edge to P_1 leading edge) (-, P_1 follows external sync; +, external sync follows P_1).

EXT SYNC INPUT

Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Ext.Sync.:,In=*** subfield. Press ON/CAL Key to set EXT SYNC IN Connector (BB) for external sync pulse input. Leading edge of P_1 occurs 7.0 µs after leading edge of external sync pulse. When external sync input is activated, external sync output is deactivated and associated subfields are blank. External sync input controls PRF and is limited same as internal PRF control.

EXT MODULATION INPUT

Press 2ND and EX MOD Keys in sequence to move cursor to Control Menu #2 ***Ext.Mod.In:*** field. Press ON/CAL Key to set ***Ext.Mod.In: ON***. Internal pulse modulation is deactivated. Interrogation is modulated by external modulation input through EXT MOD IN Connector (Z).

SCOPE TRIGGER OUTPUT

Use T_O/TAC/T_D Switch (30) to set scope trigger output through SCOPE TRIG OUT Connector (AA). Set T_O/TAC/T_D Switch (30) to ***T_O*** for viewing interrogation from GEN Connector (15). Set T_O/TAC/T_D Switch (30) to ***T_D*** for viewing reply from XMTR Connector (12).

NOTE: Connect UUT XMTR Connector (C) to Oscilloscope for viewing UUT replies through ANT B Connector (E).

6. Verify UUT reply information as follows:

FREQUENCY

Verify UUT transmitting frequency with XMTR FREQ MHz Display (51).

STEP PROCEDURE

ACCURACY

Set DISPLAY SELECT Control (40) to ***XPDR CODE*** setting and view DISPLAY SELECT Readout (43) to verify ATCRBS reply. Select XPDR MODE Control (38) ***A*** setting to verify Mode A octal ID code. Select XPDR MODE Control (38) ***AC2*** setting to verify Mode C altitude in feet.

Press S MENU Key to select sequence menu for verifying Mode S reply. Verify downlink format data fields are in accordance with Appendix E and correspond to uplink format data programmed for each active sequence menu. Refer to 1-2-5D for converting octal data to binary.

Reply pulses are displayed on Oscilloscope Channel 2.

REPLY DELAY

Reply delay is shown in Control Menu #1 ***RpDly:*** field in microseconds. Verify Mode S reply delay, P_4 leading edge to P_1 leading edge, is 128 µs (±0.5 µs). For ATCRBS only transponders, verify ATCRBS reply delay, P_3 leading edge to F_1 leading edge, is 3.0 µs (±0.5 µs).

PERCENT REPLY

Verify percent reply shown in Control Menu #1 ***%Reply:*** subfields. ***%Reply:ATC=*** subfield displays percent reply for ATCRBS through ANT A. ***%Reply:S=*** subfield displays percent reply for Mode S through ANT A. ***%Reply:AntB=*** subfield displays percent reply for ATCRBS and Mode S through ANT B. If Multi-Level Diversity option is installed, ANT B percent reply is also displayed in Control Menu #2 ***AntB%=*** field.

POWER

Verify UUT power through ANT A (RF I/O Connector (9) shown on XMTR PWR WATTS Display (1). Set F_2/P_2 F_1/P_1 Switch (34) to ***F_1/P_1*** to measure pulse power of P_1 or F_1 reply pulse only. Set F_2/P_2 F_1/P_1 Switch (34) to ***F_2/P_2*** for S-1403C to have control over pulse power measurement selection.

Select reply pulse to be measured by setting ***Pulse Power Gate:*** field. Press 2ND and PPG Keys in sequence. Use SLEW Control (F) or Keyboard (B) to select one of 116 possible Mode S reply pulses. When ATCRBS replies are received, use SLEW Control (F) or Keyboard (B) to select one of 16 possible ATCRBS reply pulses.

Measurement gate is enabled prior to rising edge of pulse to be measured. Measurement continues until next falling edge of reply.

STEP PROCEDURE

Mode S replies are pulse position modulated and adjacent pulses cause erroneous power readings during following conditions:

- If measurement pulse data is "0" and following pulse data is "1", measurement pulse (selected) and following pulse are measured together because following pulse has first detectable falling edge.
- If measurement pulse data is "1" and preceding pulse data is "0", power reading is zero because no rising edge is detected.

7. Verify UUT Mode S squitter information as follows:

INTERVAL

Verify interval between squitters shown in Control Menu #1 ***Sqtr:*** field in seconds. Normal squitter intervals range from 0.8 to 1.2 seconds.

ADDRESS

Verify squitter address shown in Control Menu #2 ***Sqtr. Add.*** field. 24-bit address from DF11 is shown as 8 octal digits.

(3) General Test Sequence (Refer to 1-2-4, Figure 28.)

SIGNAL DESCRIPTION

1. $\overline{\text{Self Interrogate}}$ Input

Active low pulse from the ATC-1400A triggers the interrogation process unless an external sync input is activated. The self interrogate pulse rising edge occurs 17.95 µs prior to P_1 leading edge or prepulse leading edge (when enabled). The self interrogate pulse is received through the AUXILIARY Connector (J10010) (JJ).

2. Prepulse Output (when enabled)

Active high pulse, 1.0 µs wide, occurs 0 to 260 µs prior to P_1 leading edge as selected and is transmitted through the PREPULSE OUT Connector (J10009) (EE).

3. Ext Sync Output (when enabled)

Active high pulse, 1.0 µs wide, occurs from 9.95 µs prior to P_1 leading edge to 9.95 µs following P_1 leading edge as selected and is transmitted through the EXT SYNC OUT Connector (J10008) (CC).

4. Ext Sync Input (when enabled)

Active high pulse occurs 7.0 µs prior to P_1 leading edge and is received through the EXT SYNC IN Connector (J10004) (BB). The external sync input replaces the self interrogate input in triggering the interrogation process.

SIGNAL DESCRIPTION

5. Scope Trigger Output

   Scope trigger is transmitted through the SCOPE TRIG OUT Connector (J10007) (AA) and depends on the T_O/TAC/T_D Switch (30) setting:

   ***T_O* POSITION** (for viewing interrogations)

   Active high pulse occurs from 1.0 µs prior to P_1 leading edge to 1.0 µs prior to P_4 leading edge.

   ***T_D* POSITION** (for viewing replies)

   Active high pulse, 8.0 µs wide, occurs 1.0 µs prior to F_1 or P_1 leading edge of the reply.

6. Mode S/$\overline{\text{ATCRBS}}$ Discrete Output

   Active low pulse, 3.0 µs wide, occurs 1.0 µs prior to P_1 leading edge and is transmitted through the MODE S/ATCRBS DISCRETE OUT Connector (J10005) (DD).

7. ANT B Output (when enabled)

   Active high ANT B interrogation pulses modulate RF transmitted through ANT B Connector (J10002) (E). P_1 leading edge of ANT B interrogation is offset from P_1 leading edge of ANT A interrogation as selected in Control Menu #1 ***AntB:*** field, in microseconds. ANT B and ANT A pulse characteristics are the same except for pulse level.

8. $\overline{\text{Ext Pulse}}$ Output

   Active low pulses transmitted through the AUXILIARY Connector (J10010) (JJ) modulate ATC-1400A RF output. Pulse characteristics vary according to test parameter settings. Refer to 1-2-4E(2).

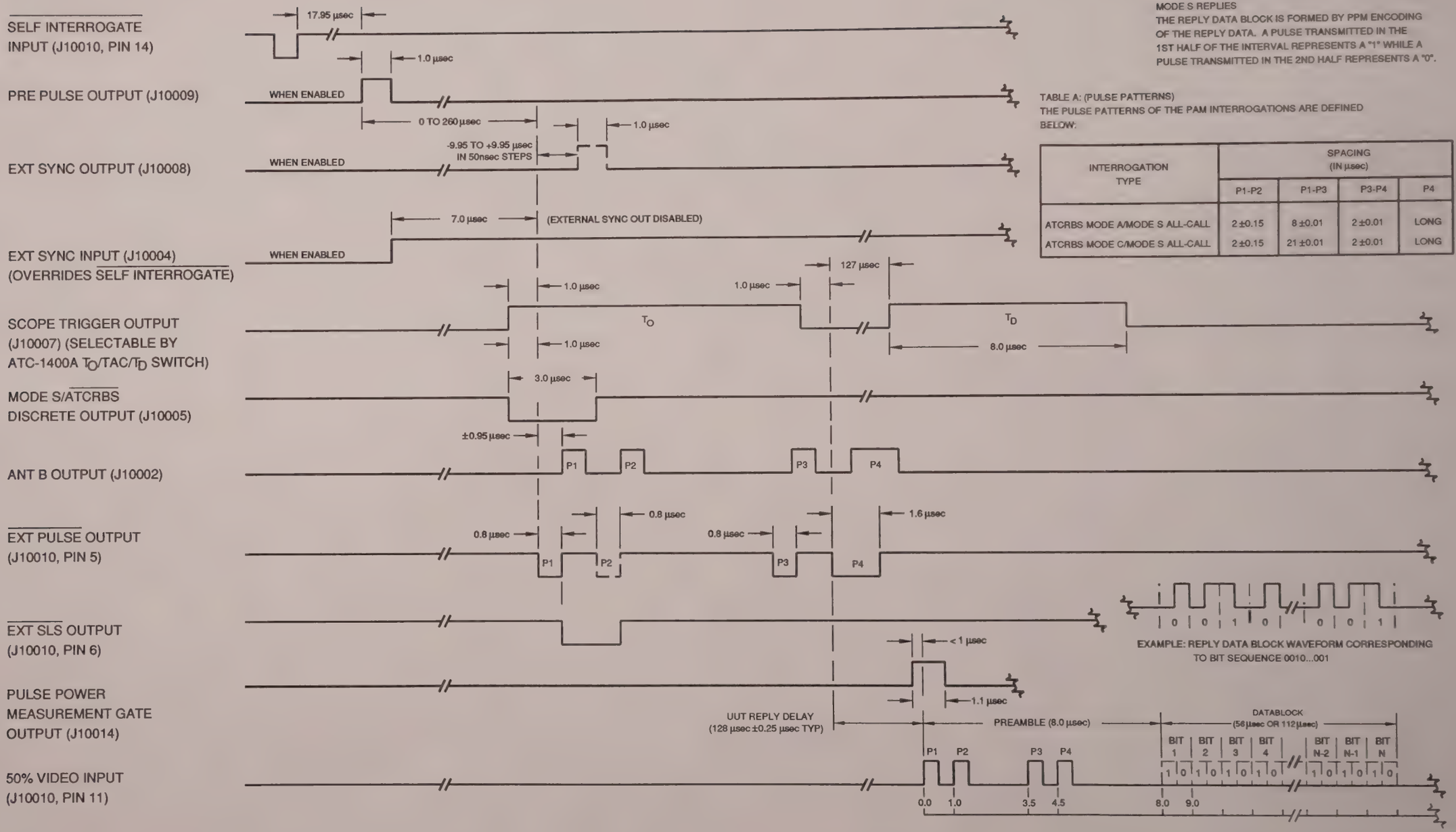
9. $\overline{\text{Ext SLS}}$ Output (when enabled)

   Active low gate pulse enables SLS/ECHO Thumbwheels (50) to control the level of P_2 (SLS) or other applicable interrogation pulses (P_3 and P_4) depending on SLS/ECHO ON/OFF Switch (18) position and Control Menu #1 pulse field settings.

10. Pulse Power Measurement Gate Output

    The pulse power measurement gate (PPMG) occurs <1.0 µs prior to leading edge of selected pulse and is transmitted to the ATC-1400A through the MEASUREMENT GATE OUT Connector (J10014) (HH).

    NOTE: The ATC-1400A ignores PPMG if the F_2/P_2 F_1/P_1 Switch (34) is set to ***F_1/P_1***.



MODE S REPLIES

THE REPLY DATA BLOCK IS FORMED BY PPM ENCODING OF THE REPLY DATA. A PULSE TRANSMITTED IN THE 1ST HALF OF THE INTERVAL REPRESENTS A "1" WHILE A PULSE TRANSMITTED IN THE 2ND HALF REPRESENTS A "0".

TABLE A: (PULSE PATTERNS)
THE PULSE PATTERNS OF THE PAM INTERROGATIONS ARE DEFINED BELOW:

INTERROGATION TYPE	SPACING (IN µsec)			
	P1-P2	P1-P3	P3-P4	P4
ATCRBS MODE A/MODE S ALL-CALL	2 ±0.15	8 ±0.01	2 ±0.01	LONG
ATCRBS MODE C/MODE S ALL-CALL	2 ±0.15	21 ±0.01	2 ±0.01	LONG

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ACL Test Function Timing Diagram
Figure 28

SIGNAL DESCRIPTION

11. 50% Video

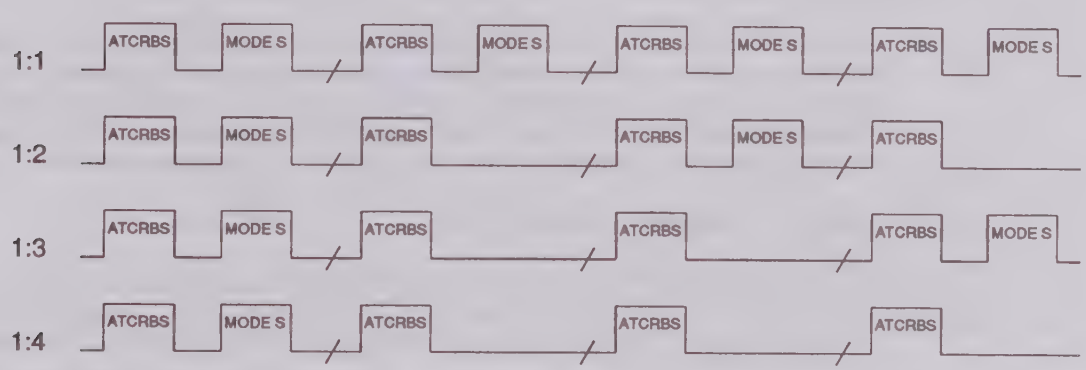
The UUT reply video is received through ANT A, the ATC-1400A and the AUXILIARY Connector (J10010) (JJ). ATCRBS replies are expected from ATCRBS only transponders and Mode S replies from Mode S transponders.

F. INTLCE Test Function

(1) Description

In the INTLCE Test Function, the Mode S Test System transmits ATCRBS interrogations interlaced with Mode S interrogations. Reply characteristics are measured to verify UUT operation in a normal mixed environment.

ATCRBS interrogations are transmitted according to the mode and PRF selected. Mode S interrogations are transmitted according to sequence menus and the ***INTLCE,Ratio 1:*** subfield setting. The first ATCRBS interrogation is followed by a Mode S interrogation. Each Mode S interrogation thereafter follows the number of ATCRBS interrogations set in the ***INTLCE,Ratio 1:*** subfield. Refer to 1-2-4, Figure 29. There is a 200 µs fixed delay from P_1 of an ATCRBS interrogation to P_1 of the following Mode S interrogation.



INTLCE Test Function Interrogation Sequence
Figure 29

(2) Procedure

STEP	PROCEDURE

1. Connect test equipment according to 1-2-4, Figure 24.
2. Apply power to Mode S Test System.
3. Verify Mode S Test System is not in any test function using sequence menus (***SEQ***; ***INTLCE***; ***DI,1st*** or ***2nd=SEQ*** or ***BURST,SEQ***). Use Keyboard (B) to select any other test function if necessary.
4. Press S MENU Key to select sequence menu.

STEP PROCEDURE

5. Set Mode S interrogation sequence as follows (refer to 1-2-2, Figure 16):

   SEQUENCE MENU

   Program sequence menus. One to four sequence menus are used in INTLCE Test Function. With cursor under ***S***(sequence number) field, use SLEW Control (F) to enter each sequence menu. Press ON/CAL Key to activate or deactivate. Activate only desired sequence menus and deactivate all others.

   NOTE: Only the first four activated sequence menus are used in INTLCE Test Function.

   FORMAT TYPE

   Use SLEW Control (F) or ON/CAL Key to select format type for each active sequence menu. ***FMT D*** displays one of seven defined sequence menus depending on ***UF#*** field. ***FMT S*** displays unspecified short message field (9 octal digits) along with UUT address. ***FMT L*** displays unspecified long message field (28 octal digits) along with UUT address.

   UPLINK FORMAT NUMBER

   Move cursor to ***UF#*** field. Use SLEW Control (F) or Keyboard (B) to select desired uplink format number from ***00*** to ***31*** for unspecified short or long formats. Select UF00, UF04, UF05, UF11, UF16, UF20 or UF21 for defined formats.

   DATA FIELDS

   Use Keyboard (B) to load data fields according to Appendix E. Refer to 1-2-5D for converting data to octal. Short message fields range from ***0*** to ***777777777***. Long message fields range from ***0*** to ***3777777777777777 777777777777***. Refer to Appendix B for defined fields.

6. Select INTLCE Test Function. Press 2ND, FUN NO and "5" Keys in sequence or move cursor to ***Func:*** field and press "5" Key.

7. Press CURSOR Key (→) (A) to move cursor to ***INTLCE,Ratio 1:*** subfield.

8. Use SLEW Control (F) or Keyboard (B) to set number of ATCRBS interrogations (***1*** to ***999***) to be sent with every one Mode S interrogation.

9. Set test parameters as follows:

   MODE SELECTION

   Use XPDR MODE Control (38) to select ATCRBS interrogation mode. Select interrogation mode (***1***, ***2***, ***T***, ***A***, ***B***, ***C*** or ***D***). Select AC_2 for Mode C interrogations when decoded reply in feet is desired on DISPLAY SELECT Readout (43). AC_1 is not used.

STEP PROCEDURE

FREQUENCY

Adjust FREQ/FUNCTION Thumbwheels (45) and ΔF Thumbwheels (48) to set interrogation RF from ***952.01*** to ***1222.99*** MHz. Set to ***1030*** MHz for normal operation.

RF LEVEL

Adjust RF level from -130 to +3 dBm (-69 to -21 dBm is normal operating range) using RF LEVEL -dBm Display (3), RF LEVEL Control (6) and Control Menu #1 ***RFLvl:*** field. Adjust RF LEVEL Control (6) to set RF LEVEL -dBm Display (3) from ***127*** to ***0*** (-127 to 0 dBm). Press RF LVL Key to move cursor to Control Menu #1 ***RFLvl:*** field. Use Keyboard (B) or SLEW Control (F) to set ***RFLvl:*** field from ***-3.0*** to ***+3.0 dB*** to offset cable loss. Press ENT Key to enter selected value.

INTERROGATION RATE

Set interrogation rate or PRF using PRF/SQTR Thumbwheels (41). PRF limitations depend on Control Menu #1 ***INTLCE,Ratio 1:*** subfield setting. Adjust PRF from ***0*** to ***400*** when ratio is set ***1:2***. Adjust PRF from ***0*** to ***600*** when ratio is set ***1:3***. Adjust PRF from ***0*** to ***800*** when ratio is set ***1:4***. Adjust PRF from ***0*** to ***900*** when ratio is set ***1:≥5***. Each of four possible activated sequence menus is one Mode S interrogation. PRF for entire sequence depends on number of activated sequence menus, ***INTLCE,Ratio 1:*** field setting and actual PRF set.

P_2 (SLS) LEVEL

Set SLS/ECHO ON/OFF Switch (18) to ***ON***. Set P_2 (SLS) level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. Verify suppression occurs when P_2 level equals or exceeds P_1 level. Verify suppression does not occur when P_1 level exceeds P_2 level by 9 dB or more.

INTERFERENCE PULSE

Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+***. Interference pulse is activated and positioned at -17.5 to +399.0 μs from leading edge of P_1. Set level from ***-19*** to ***+6*** dB (relative to P_1) using SLS/ECHO Thumbwheels (50). Set width from 0.2 to 5 μs using INTRF PULSE WIDTH Control (31).

SUPPRESSOR PULSE

Connect SUPPRESSOR OUTPUT Connector (16) to UUT suppressor input. Set SUPPRESSOR ON/OFF Switch (17) to ***ON*** to activate suppressor pulse. Adjust level from 3 to 27 V using SUPPRESSOR VAR Adjustment (19). When DBL INTERR/INTRF PULSE Thumbwheels (42) are ***OFF***, suppressor pulse position is 0.8 µs prior to SPR. Activate interference pulse to control position of suppressor pulse (suppressor pulse replaces interference pulse when both are activated). Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+*** to adjust suppressor pulse position from -17.5 to +399.0 µs relative to P_1. Width is fixed at 33 µs.

ANT B

Press 2ND and ANT B Keys in sequence to move cursor to Control Menu #1 ***AntB:*** field. Press ON/CAL Key to activate interrogations through ANT B Connector (E). Use SLEW Control (F) or Keyboard (B) to enter value from ***-0.95*** to ***+0.95*** (offset in 0.05 µs increments from ANT A interrogations).

If Multi-Level Diversity option is installed, set ANT B output level. Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Brf=*** and ***BrfIvl=*** fields. Using SLEW Control (F) or Keyboard (B), set ***Brf=*** field from ***-80*** to ***-20 dBm*** and ***BrfIvl=*** field from ***-3.0*** to ***+3.0 dB*** (used to offset cable loss).

10. If desired, set optional inputs and outputs as follows:

PREPULSE

Press 2ND and P PULS Keys in sequence to move cursor to Control Menu #2 ***Prepulse:*** field. Press ON/CAL Key to activate prepulse through PREPULSE OUT Connector (EE). Use SLEW Control (F) or Keyboard (B) to enter value from ***0*** to ***260*** (time in microseconds from prepulse leading edge to P_1 leading edge of ATCRBS interrogation).

NOTE: Prepulse does not operate as specified when activated at the same time as external sync input.

EXT SYNC OUTPUT

Press 2ND and EXT SYN Keys in sequence to move cursor to Control Menu #2 ***Ext.Sync.:Out=*** subfield. Press ON/CAL Key to activate external sync pulse through the EXT SYNC OUT Connector (CC). Use SLEW Control (F) or Keyboard (B) to set ***Ext.Sync.:Dv=*** subfield value from ***-9.95*** to ***+9.95*** (time in microseconds from external sync pulse leading edge to P_1 leading edge of the ATCRBS interrogation) (**-**, P_1 follows external sync; **+**, external sync follows P_1).

STEP PROCEDURE

EXT SYNC INPUT

Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Ext.Sync.:,In=*** subfield. Press ON/CAL Key to set EXT SYNC IN Connector (BB) for external sync pulse input. Leading edge of P_1 occurs 7.0 µs after leading edge of external sync pulse. When external sync input is activated, external sync output is deactivated and associated subfields are blank. External sync input controls PRF and is limited same as internal PRF control.

EXT MODULATION INPUT

Press 2ND and EX MOD Keys in sequence to move cursor to Control Menu #2 ***Ext.Mod.In:*** field. Press ON/CAL Key to set ***Ext.Mod.In: ON***. Internal pulse modulation is deactivated. Interrogation is modulated by external modulation input through EXT MOD IN Connector (Z).

SCOPE TRIGGER OUTPUT

Use T_O/TAC/T_D Switch (30) to set scope trigger output through SCOPE TRIG OUT Connector (AA). Set T_O/TAC/T_D Switch (30) to ***T_O*** for viewing interrogation from GEN Connector (15). Set T_O/TAC/T_D Switch (30) to ***T_D*** for viewing reply from XMTR Connector (12).

NOTE: Connect UUT XMTR Connector (C) to Oscilloscope for viewing UUT replies through ANT B Connector (E).

11. Verify UUT reply information as follows:

FREQUENCY

Verify UUT transmitting frequency with XMTR FREQ MHz Display (51).

ACCURACY

Set DISPLAY SELECT Control (40) to ***XPDR CODE*** setting and view DISPLAY SELECT Readout (43) to verify ATCRBS reply. Select XPDR MODE Control (38) ***A*** setting to verify Mode A octal ID code. Select XPDR MODE Control (38) ***AC_2*** setting to verify Mode C altitude in feet.

Press S MENU Key to select sequence menu for verifying Mode S reply. Verify downlink format data fields are in accordance with Appendix E and correspond to uplink format data programmed for each active sequence menu. Refer to 1-2-5D for converting octal data to binary.

Reply pulses are displayed on Oscilloscope Channel 2.

STEP PROCEDURE

REPLY DELAY

Reply delay is shown in Control Menu #1 ***RpDly:*** field in microseconds. Verify reply delay, P_3 leading edge of ATCRBS interrogation to F_1 leading edge of ATCRBS reply is 3.0 µs (±0.5 µs).

PERCENT REPLY

Verify percent reply shown in Control Menu #1 ***%Reply:*** subfields. ***%Reply:ATC=*** subfield displays percent reply for ATCRBS through ANT A. ***%Reply:S=*** subfield displays percent reply for Mode S through ANT A. ***%Reply:AntB=*** subfield displays percent reply for ATCRBS and Mode S through ANT B. If Multi-Level Diversity option is installed, ANT B percent reply is also displayed in Control Menu #2 ***AntB%=*** field.

POWER

Verify UUT power (only for ATCRBS interrogations) through ANT A (RF I/O Connector (9) shown on XMTR PWR WATTS Display (1). Set F_2/P_2 F_1/P_1 Switch (34) to ***F_1/P_1*** to measure pulse power of F_1 reply pulse only. Set F_2/P_2 F_1/P_1 Switch (34) to ***F_2/P_2*** for S-1403C to have control over pulse power measurement selection.

Select reply pulse to be measured by setting ***Pulse Power Gate:*** field. Press 2ND and PPG Keys in sequence. Use SLEW Control (F) to select one of 16 possible ATCRBS reply pulses.

12. Verify UUT Mode S squitter information as follows:

INTERVAL

Verify interval between squitters shown in Control Menu #1 ***Sqtr:*** field in seconds. Normal squitter intervals range from 0.8 to 1.2 seconds.

ADDRESS

Verify squitter address shown in Control Menu #2 ***Sqtr. Add.*** field. 24-bit address from DF11 is shown as 8 octal digits.

(3) General Test Sequence (Refer to 1-2-4, Figure 30.)

SIGNAL DESCRIPTION

1. $\overline{\text{Self Interrogate}}$ Input

Active low pulse from the ATC-1400A triggers the interrogation process unless an external sync input is activated. The self interrogate pulse rising edge occurs 17.95 µs prior to P_1 leading edge or prepulse leading edge (when enabled). The self interrogate pulse is received through the AUXILIARY Connector (J10010) (JJ).

SIGNAL DESCRIPTION

2. Prepulse Output (when enabled)

   Active high pulse, 1.0 µs wide, occurs 0 to 260 µs (as selected) prior to P_1 leading edge of the ATCRBS interrogation and is transmitted through the PREPULSE OUT Connector (J10009) (EE).

3. Ext Sync Output (when enabled)

   Active high pulse, 1.0 µs wide, occurs from 9.95 µs prior to P_1 leading edge to 9.95 µs following P_1 leading edge as selected and is transmitted through the EXT SYNC OUT Connector (J10008) (CC).

4. Ext Sync Input (when enabled)

   Active high pulse occurs 7.0 µs prior to P_1 leading edge of the ATCRBS interrogation and is received through the EXT SYNC IN Connector (J10004) (BB). The external sync input replaces the self interrogate input in triggering the interrogation process.

5. Scope Trigger Output

   Scope trigger is transmitted through the SCOPE TRIG OUT Connector (J10007) (AA) and depends on the T_O/TAC/T_D Switch (30) setting:

   ***T_O* POSITION** (for viewing interrogations)

   Active high pulse occurs from 1.0 µs prior to P_1 leading edge of the ATCRBS interrogation to 1.0 µs prior to F_1 of the ATCRBS reply.

   ***T_D* POSITION** (for viewing replies)

   Active high pulse occurs from 1.0 µs prior to P_1 leading edge of the Mode S interrogation to 1.0 µs prior to P_1 of the Mode S reply.

6. Mode S/$\overline{\text{ATCRBS}}$ Discrete Output

   Active low pulse, 3.0 µs wide, occurs 1.0 µs prior to P_1 leading edge and is transmitted through the MODE S/ATCRBS DISCRETE OUT Connector (J10005) (DD).

7. ANT B Output (when enabled)

   Active high ANT B interrogation pulses modulate RF transmitted through ANT B Connector (J10002) (E). P_1 leading edge of ANT B interrogation is offset from P_1 leading edge of ANT A interrogation as selected in Control Menu #1 ***AntB:*** field, in microseconds. ANT B and ANT A pulse characteristics are the same except for pulse level.

8. $\overline{\text{Ext Pulse}}$ Output

   Active low pulses transmitted through the AUXILIARY Connector (J10010) (JJ) modulate ATC-1400A RF output. Pulse characteristics vary according to test parameter settings. Refer to 1-2-4F(2).

SIGNAL DESCRIPTION

9. $\overline{\text{Ext SLS}}$ Output (when enabled)

   Active low gate pulse enables SLS/ECHO Thumbwheels (50) to control the level of P_2 (SLS) depending on SLS/ECHO ON/OFF Switch (18) position.

10. DPSK Output

    The DPSK output contains the uplink format data information used to modulate the ANT A interrogation signal. The data constantly changes when more than one uplink format is being sent in an interrogation sequence. The first synchronous phase reversal (SPR) occurs 1.25 µs following P_6 leading edge and is transmitted through the DPSK OUT Connector (J10015) (II) to the ATC-1400A.

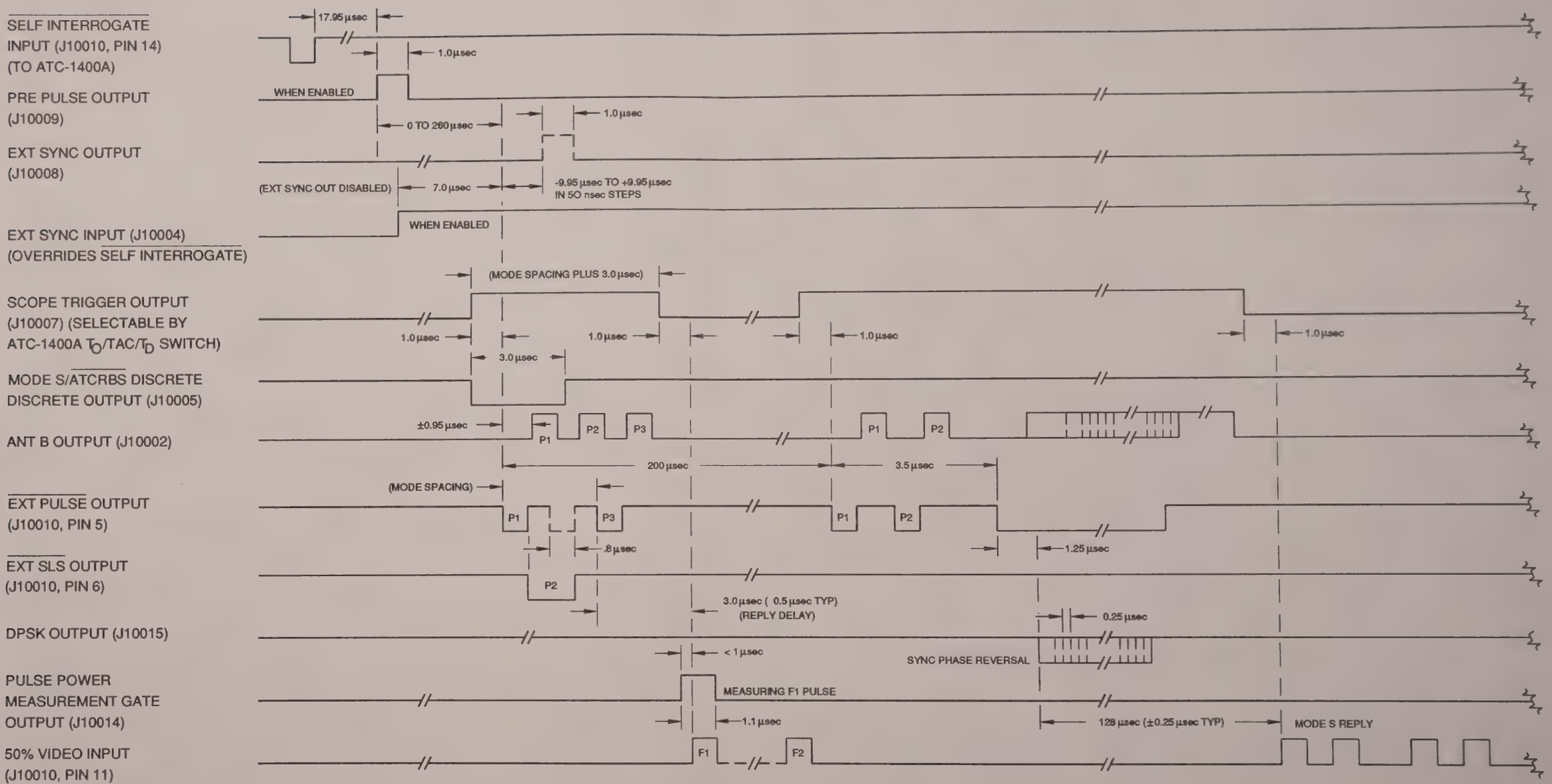
11. Pulse Power Measurement Gate Output

    The pulse power measurement gate (PPMG) occurs <1.0 µs prior to leading edge of selected pulse and is transmitted to the ATC-1400A through the MEASUREMENT GATE OUT Connector (J10014) (HH).

    NOTE: The ATC-1400A ignores PPMG if the F_2/P_2 F_1/P_1 Switch (34) is set to ***F_1/P_1***.

12. 50% Video

    The UUT reply video is received through ANT A, the ATC-1400A and the AUXILIARY Connector (J10010) (JJ).



8814001

INTLCE Test Function Timing Diagram
Figure 30

G. DI Test Function

(1) Description

In the DI Test Function, the Mode S Test System generates two interrogations in a single interrogation period. The interrogations consist of any combination of ATCRBS, All-Call and/or Mode S. The DI Test Function is used to verify transponder operation and recovery. Variable pulse control is valid for the first interrogation only.

(2) Procedure

STEP PROCEDURE

1. Connect test equipment according to 1-2-4, Figure 24.

2. Apply power to Mode S Test System.

3. Select DI Test Function. Press 2ND, FUN NO and "6" Keys in sequence or move cursor to ***Func:*** field and press "6" Key.

4. Set DBL INTERR/INTRF PULSE Thumbwheels (42) to ***DOUBLE***. Select desired spacing between interrogations (DI delay) from ***000.0*** to ***399.9*** in microseconds.

   NOTE: Some settings of DBL INTERR/INTRF Thumbwheels (42) may cause invalid reply delay information. Refer to **REPLY DELAY** in Step 11.

5. Select test function modes for first and second interrogations.

   Use CURSOR Keys (A) and ON/CAL Key to set ***DI,1st=*** and ***2nd=*** subfields to desired test function modes (***ATC***, ***SEQ***, ***ACS*** or ***ACL)***.

   NOTE: If Mode S interrogations (***SEQ***) are used, set sequence menus according to Steps 6 and 7, prior to selecting ***SEQ*** as test function mode. If only ATCRBS and All-Call interrogations are used, proceed at Step 8.

6. Press S MENU Key to enter sequence menu.

7. Refer to 1-2-2, Figure 16 and set Mode S interrogation sequence as follows:

   SEQUENCE MENU

   Program sequence menus. One to four sequence menus are used in DI Test Function. With cursor under ***S***(sequence number) field, use SLEW Control (F) to enter each sequence menu. Press ON/CAL Key to activate or deactivate sequence menus. Activate only desired sequence menus and deactivate all others.

   NOTE: Only the first four activated sequence menus are used in DI Test Function.

STEP PROCEDURE

FORMAT TYPE

Use SLEW Control (F) or ON/CAL Key to select format type for each active sequence menu. ***FMT D*** displays one of seven defined sequence menus depending on ***UF#*** field. ***FMT S*** displays unspecified short message field (9 octal digits) along with UUT address. ***FMT L*** displays unspecified long message field (28 octal digits) along with UUT address.

UPLINK FORMAT NUMBER

Move cursor to ***UF#*** field. Use SLEW Control (F) or Keyboard (B) to select desired uplink format number from ***00*** to ***31*** for unspecified short or long formats. Select UF00, UF04, UF05, UF11, UF16, UF20 or UF21 for defined formats.

DATA FIELDS

Use Keyboard (B) to load data fields according to Appendix E. Refer to 1-2-5D for converting data to octal. Short message fields range from ***0*** to ***777777777***. Long message fields range from ***0*** to ***3777777777777777 777777777777***. Refer to Appendix B for defined fields.

8. Set test parameters as follows:

MODE SELECTION

If test function modes ***ATC***, ***ACS*** and/or ***ACL*** are selected in Step 5, use XPDR MODE Control (38) to select P_1 to P_3 pulse spacing. Select interrogation mode (***1***, ***2***, ***T***, ***A***, ***B***, ***C*** or ***D***). Select AC_2 for Mode C interrogations when decoded reply in feet is desired on DISPLAY SELECT Readout (43). AC_1 is not used. Mode selected sets one or both interrogations depending on test function modes selected in Step 5.

FREQUENCY

Adjust FREQ/FUNCTION Thumbwheels (45) and ΔF Thumbwheels (48) to set interrogation RF from ***952.01*** to ***1222.99*** MHz. Set to ***1030*** MHz for normal operation.

RF LEVEL

Adjust RF level from -130 to +3 dBm (-69 to -21 dBm is normal operating range) using RF LEVEL -dBm Display (3), RF LEVEL Control (6) and Control Menu #1 ***RFLvl:*** field. Adjust RF LEVEL Control (6) to set RF LEVEL -dBm Display (3) from ***127*** to ***0*** (-127 to 0 dBm). Press RF LVL Key to move cursor to Control Menu #1 ***RFLvl:*** field. Use Keyboard (B) or SLEW Control (F) to set ***RFLvl:*** field from ***-3.0*** to ***+3.0 dB*** to offset cable loss. Press ENT Key to enter selected value.

STEP PROCEDURE

INTERROGATION RATE

Set interrogation rate or PRF using PRF/SQTR Thumbwheels (41). Adjust PRF from ***0*** to ***750*** when ***DI,1st=ATC,2nd=ATC*** Adjust PRF from ***0*** to ***100*** for any other test function mode combination.

9. Set pulse characteristics for first interrogation according to test function mode selected. Second interrogation is not adjustable.

PULSE WIDTH

Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***CAL*** for 0.8 µs nominal width of P_1, P_2 (if activated) and P_3 (if applicable) interrogation pulses. Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***VAR*** and use XPDR PULSE WIDTH Thumbwheels (49) to adjust width from ***0.20*** to ***1.85*** µs.

P_2 LEVEL (*DI,1st=SEQ*)

Set SLS/ECHO ON/OFF Switch (18) to ***OFF***. Press 2ND and P2 Keys in sequence to move cursor to Control Menu #1 ***P2:*** field. Press ON/CAL Key to set ***P2:VAR***. Set P_2 level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. (0 dB is normal operating level (***P2:CAL***). When P_2 deactivation is desired, press ON/CAL Key to set ***P2:*** field to ***OFF***.

P_2 POSITION (*DI,1st=SEQ*)

Set XPDR DEV P_2/CAL Switch (28) to ***CAL*** for nominal P_2 position of 2.0 µs following P_1 leading edge. Set XPDR DEV P_2/CAL Switch (28) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to set position from 0.15 to 3.85 µs following P_1 leading edge.

P_2 (SLS) LEVEL (*DI,1st=ATC* or *ACS* or *ACL*)

Set SLS/ECHO ON/OFF Switch (18) to ***ON***. Set P_2 (SLS) level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. Verify suppression occurs when P_2 level equals or exceeds P_1 level. Verify suppression does not occur when P_1 level exceeds P_2 level by 9 dB or more.

P_2 (SLS) POSITION (*DI,1st=ATC* or *ACS* or *ACL*)

Set XPDR DEV P_2/CAL Switch (28) to ***CAL*** for normal P_2 (SLS) position of 2.0 µs following P_1 leading edge. Set XPDR DEV P_2/CAL Switch (28) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to set position from 0.15 to 3.85 µs following P_1 leading edge.

P_4 LEVEL (*DI,1st=ACS* or *ACL*)

Set SLS/ECHO ON/OFF Switch (18) to ***OFF***. Press 2ND and P4(P6) Keys in sequence to move cursor to Control Menu #1 ***P4:*** field. Press ON/CAL Key to set ***P4:VAR***. Set P_4 level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. 0 dB is normal operating level (***P4:CAL***). When P_4 deactivation is desired, press ON/CAL Key to set ***P4:OFF***.

P_4 WIDTH (*DI,1st=ACS* or *ACL*)

P_4 width is adjustable from 0.2 to 2.75 µs for ACS or from 0.2 to 3.55 µs for ACL. Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P4:,Wd=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-0.60*** to ***+1.95*** (time deviated from 0.8 µs in 0.05 µs increments) for ACS or from ***-1.40*** to ***+1.95*** (time deviated from 1.6 µs in 0.05 µs increments) for ACL.

NOTE: When P_4 is set wider than 1.5 µs, ATCRBS Only All-Call becomes ATCRBS/Mode S All-Call. When P_4 is set <1.2 µs, ATCRBS/Mode S All-Call becomes ATCRBS Only All-Call.

P_4 POSITION (*DI,1st=ACS* or *ACL*)

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P4:,Dv=*** subfield. ***P4:,Dv= CAL*** sets nominal P_4 position at 2.0 µs following leading edge of P_3. P_4 position is adjustable from 0.05 to 3.95 µs following leading edge of P_3. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.95*** to ***+1.95*** (time deviated from 2.0 µs in 0.05 µs increments).

P_5 (SLS) LEVEL (*DI,1st=SEQ*)

Set SLS/ECHO ON/OFF Switch (18) to ***ON***. Set P_5 (SLS) level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. Verify suppression occurs when P_5 level exceeds P_6 level by 3 dB or more. Verify suppression does not occur when P_6 level exceeds P_5 level by 12 dB or more.

P_5 (SLS) POSITION (*DI,1st=SEQ*)

P_5 (SLS) position is centered on SPR. Adjusting SPR position changes P_5 position accordingly. Use SLEW Control (F) or Keyboard (B) to set Control Menu #1 ***SPR:,Dv=*** field from ***-1.00*** to ***+1.00*** (time deviated from nominal position in 0.05 µs increments).

P_6 CONTROL (*DI,1st=SEQ*)

Press 2ND and P4(P6) Keys in sequence to move cursor to Control Menu #1 ***P6:*** field. Press ON/CAL Key to deactivate or activate P_6 pulse.

P_6 WIDTH (*DI,1st=SEQ*)

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P6:,Wd=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.50*** to ***+1.50*** (time deviated from nominal widths in 0.05 µs increments). Nominal widths are 16.25 µs for 56-bit data field and 30.25 µs for 112-bit data field (Control Menu #1 ***P6:,Wd= CAL***).

P_6 POSITION (*DI,1st=SEQ*)

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P6:,Dv=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to select variable value from ***-1.95*** to ***+1.95*** (time deviated from nominal position in 0.05 µs increments). Nominal position is 3.5 µs following P_1 leading edge (control Menu #1 ***P6:,Dv= CAL***).

SPR CONTROL (*DI,1st=SEQ*)

Press 2ND and SPR Keys in sequence to move cursor to Control Menu #1 ***SPR:*** field. Press ON/CAL Key to deactivate or activate SPR.

SPR POSITION (*DI,1st=SEQ*)

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***SPR:,Dv=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.00*** to ***+1.00*** (time deviated from nominal position in 0.05 µs increments). Nominal position is 1.25 µs following P_6 leading edge (Control Menu #1 ***SPR:,Dv= CAL***).

INTERFERENCE PULSE

Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+***. Interference pulse is activated and positioned at -17.5 to +399.0 µs from leading edge of P_1. Set level from ***-19*** to ***+6*** dB (relative to P_1) using SLS/ECHO Thumbwheels (50). Set width from 0.2 to 5 µs using INTRF PULSE WIDTH Control (31).

SUPPRESSOR PULSE

Connect SUPPRESSOR OUTPUT Connector (16) to UUT suppressor input. Set SUPPRESSOR ON/OFF Switch (17) to ***ON*** to activate suppressor pulse. Adjust level from 3 to 27 V using SUPPRESSOR VAR Adjustment (19). When DBL INTERR/INTRF PULSE Thumbwheels (42) are ***OFF***, suppressor pulse position is 0.8 µs prior to SPR. Activate interference pulse to control position of suppressor pulse (suppressor pulse replaces interference pulse when both are activated). Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+*** to adjust suppressor pulse position from -17.5 to +399.0 µs relative to P_1. Width is fixed at 33 µs.

STEP PROCEDURE

ANT B

Press 2ND and ANT B Keys in sequence to move cursor to Control Menu #1 ***AntB:*** field. Press ON/CAL Key to activate interrogations through ANT B Connector (E). Use SLEW Control (F) or Keyboard (B) to enter value from ***-0.95*** to ***+0.95*** (offset in 0.05 µs increments from ANT A interrogations).

If Multi-Level Diversity option is installed, set ANT B output level. Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Brf=*** and ***BrfIvl=*** fields. Using SLEW Control (F) or Keyboard (B), set ***Brf=*** field from ***-80*** to ***-20 dBm*** and ***BrfIvl=*** field from ***-3.0*** to ***+3.0 dB*** (used to offset cable loss).

10. If desired, set optional inputs and outputs as follows:

PREPULSE

Press 2ND and P PULS Keys in sequence to move cursor to Control Menu #2 ***Prepulse:*** field. Press ON/CAL Key to activate prepulse through PREPULSE OUT Connector (EE). Use SLEW Control (F) or Keyboard (B) to enter value from ***0*** to ***260*** (time in microseconds from prepulse leading edge to P_1 leading edge).

NOTE: Prepulse does not operate as specified when activated at the same time as external sync input.

EXT SYNC OUTPUT

Press 2ND and EXT SYN Keys in sequence to move cursor to Control Menu #2 ***Ext.Sync.:Out=*** subfield. Press ON/CAL Key to activate external sync pulse through EXT SYNC OUT Connector (CC). Use SLEW Control (F) or Keyboard (B) to set ***Ext.Sync.:,Dv=*** subfield value from ***-9.95*** to ***+9.95*** (time in microseconds from external sync pulse leading edge to P_1 leading edge) (**-**, P_1 follows external sync; **+**, external sync follows P_1).

EXT SYNC INPUT

Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Ext.Sync.:,In=*** subfield. Press ON/CAL Key to set EXT SYNC IN Connector (BB) for external sync pulse input. Leading edge of P_1 occurs 7.0 µs after leading edge of external sync pulse. When external sync input is activated, external sync output is deactivated and associated subfields are blank. External sync input controls PRF and is limited same as internal PRF control.

SCOPE TRIGGER OUTPUT

Use To/TAC/TD Switch (30) to set scope trigger output through SCOPE TRIG OUT Connector (AA). Set To/TAC/TD Switch (30) to ***To*** for viewing interrogation from GEN Connector (15). Set To/TAC/TD Switch (30) to ***TD*** for viewing reply from XMTR Connector (12).

NOTE: Connect UUT XMTR Connector (C) to Oscilloscope for viewing UUT replies through ANT B Connector (E).

11. Verify UUT reply information as follows:

FREQUENCY

Verify UUT transmitting frequency with XMTR FREQ MHz Display (51).

ACCURACY

Set DISPLAY SELECT Control (40) to ***XPDR CODE*** setting and view DISPLAY SELECT Readout (43) to verify ATCRBS reply. Select XPDR MODE Control (38) ***A*** setting to verify Mode A octal ID code. Select XPDR MODE Control (38) ***AC2*** setting to verify Mode C altitude in feet.

Press S MENU Key to select sequence menu for verifying Mode S reply. Verify downlink format data fields are in accordance with Appendix E and correspond to uplink format data programmed for each active sequence menu. Refer to 1-2-5D for converting octal data to binary.

Reply pulses are displayed on Oscilloscope Channel 2.

REPLY DELAY

Verify reply delay according to test function mode selected. First reply received is used for reply delay measurement shown in Control Menu #1 ***RpDly:*** field in microseconds. Verify ATCRBS reply delay, measured from P_3 leading edge to F_1 leading edge is 3.00 µs (±0.5 µs). Verify Mode S reply delay, measured from SPR or P_4 leading edge to P_1 leading edge in reply is 128 µs (±0.5 µs).

NOTE: Invalid reply delay information may result if DI delay set by DBL INTERR/INTRF PULSE Thumbwheels (42) causes following circumstances:

- P_1 of second interrogation is placed within reply delay range of possible Mode S reply to first interrogation (***DI,1st=SEQ***, ***ACS*** or ***ACL***).
- First reply is to second interrogation, but is within reply delay range of possible Mode S reply to first interrogation (***DI,1st=ACS*** and ***2nd=ATC***, ***ACS*** or ***ACL***).

- P_1 of second interrogation occurs prior to expected ATCRBS reply delay to first interrogation (***DI,1st=ATC***, ***ACS*** or ***ACL***).

- P_1 of second interrogation occurs prior to trailing edge of last pulse in first interrogation.

PERCENT REPLY

Verify percent reply shown in Control Menu #1 ***%Reply:*** subfields. ***%Reply:ATC=*** subfield displays percent reply for ATCRBS through ANT A. ***%Reply:S=*** subfield displays percent reply for Mode S through ANT A. ***%Reply:AntB=*** subfield displays percent reply for ATCRBS and Mode S through ANT B. If Multi-Level Diversity option is installed, ANT B percent reply is also displayed in Control Menu #2 ***AntB%=*** field.

POWER

Verify UUT power (first interrogation only) through ANT A (RF I/O Connector (9) shown on XMTR PWR WATTS Display (1). Set F_2/P_2 F_1/P_1 Switch (34) to ***F_1/P_1*** to measure pulse power of P_1 or F_1 reply pulse only. Set F_2/P_2 F_1/P_1 Switch (34) to ***F_2/P_2*** for S-1403C to have control over pulse power measurement selection.

Select reply pulse to be measured by setting ***Pulse Power Gate:*** field. Press 2ND and PPG Keys in sequence. Use SLEW Control (F) or Keyboard (B) to select one of 16 possible ATCRBS reply pulses or 116 possible Mode S reply pulses depending on reply.

Measurement gate is enabled prior to rising edge of pulse to be measured. Measurement continues until next falling edge of reply. Mode S replies are pulse position modulated and adjacent pulses cause erroneous power readings during following conditions:

- If measurement pulse data is "0" and following pulse data is "1", measurement pulse (selected) and following pulse are measured together because following pulse has first detectable falling edge.

- If measurement pulse data is "1" and preceding pulse data is "0", power reading is zero because no rising edge is detected.

12. Verify UUT Mode S squitter information as follows:

INTERVAL

Verify interval between squitters shown in Control Menu #1 ***Sqtr:*** field in seconds. Normal squitter intervals range from 0.8 to 1.2 seconds.

STEP PROCEDURE

ADDRESS

Verify squitter address shown in Control Menu #2 ***Sqtr. Add.*** field. 24-bit address from DF11 is shown as 8 octal digits.

(3) General Test Sequence (Refer to 1-2-4, Figure 31.)

SIGNAL DESCRIPTION

1. $\overline{\text{Self Interrogate}}$ Input

   Active low pulse from the ATC-1400A triggers the interrogation process unless an external sync input is activated. The self interrogate pulse rising edge occurs 17.95 µs prior to P_1 leading edge or prepulse leading edge (when enabled). The self interrogate pulse is received through the AUXILIARY Connector (J10010) (JJ).

2. Prepulse Output (when enabled)

   Active high pulse, 1.0 µs wide, occurs 0 to 260 µs (as selected) prior to P_1 leading edge of the first interrogation and is transmitted through the PREPULSE OUT Connector (J10009) (EE).

3. Ext Sync Output (when enabled)

   Active high pulse, 1.0 µs wide, occurs from 9.95 µs prior to P_1 leading edge to 9.95 µs following P_1 leading edge as selected and is transmitted through the EXT SYNC OUT Connector (J10008) (CC).

4. Ext Sync Input (when enabled)

   Active high pulse occurs 7.0 µs prior to P_1 leading edge of the first interrogation and is received through the EXT SYNC IN Connector (J10004) (BB). The external sync input replaces the self interrogate input in triggering the interrogation process.

5. Scope Trigger Output

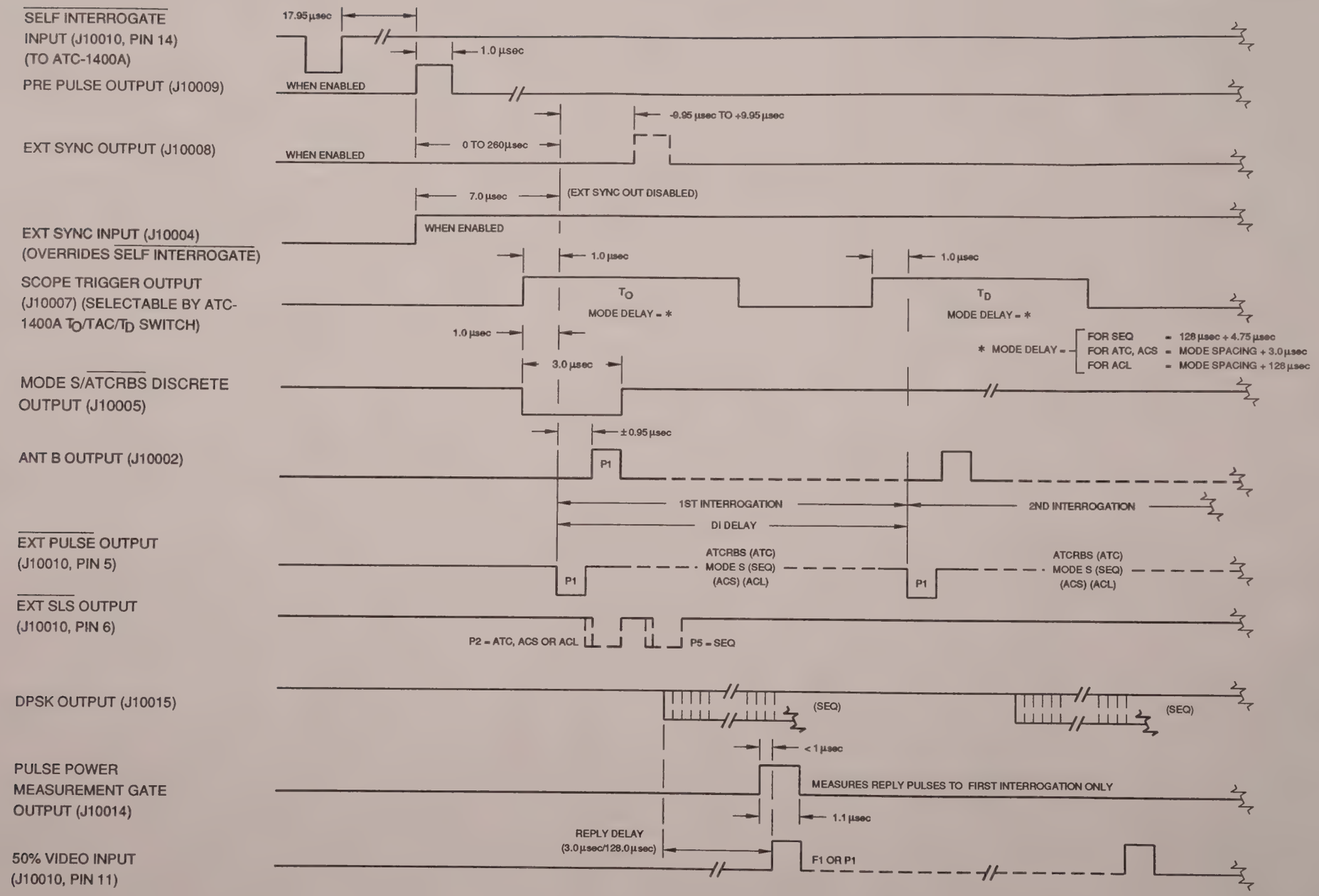
   Scope trigger is transmitted through the SCOPE TRIG OUT Connector (J10007) (AA) and depends on the T_O/TAC/T_D Switch (30) setting:

   ***T_O* POSITION** (for viewing interrogations)

   Active high pulse occurs from 1.0 µs prior to P_1 leading edge of the first interrogation to 1.0 µs prior to F_1 or P_1 of the expected reply.

   ***T_D* POSITION** (for viewing replies)

   Active high pulse occurs from 1.0 µs prior to P_1 leading edge of the second interrogation to 1.0 µs prior to F1 or P_1 of the expected reply.



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DI Test Function Timing Diagram
Figure 31

SIGNAL DESCRIPTION

6. Mode S/$\overline{\text{ATCRBS}}$ Discrete Output

   Active low pulse, 3.0 µs wide, occurs 1.0 µs prior to P_1 leading edge and is transmitted through the MODE S/ATCRBS DISCRETE OUT Connector (J10005) (DD).

7. ANT B Output (when enabled)

   Active high ANT B interrogation pulses modulate RF transmitted through ANT B Connector (J10002) (E). P_1 leading edge of ANT B interrogation is offset from P_1 leading edge of ANT A interrogation as selected in Control Menu #1 ***AntB:*** field, in microseconds. ANT B and ANT A pulse characteristics are the same except for pulse level.

8. $\overline{\text{Ext Pulse}}$ Output

   Active low pulses transmitted through the AUXILIARY Connector (J10010) (JJ) modulate ATC-1400A RF output. Pulse characteristics vary according to test parameter settings. Refer to 1-2-4G(2).

9. $\overline{\text{Ext SLS}}$ Output (when enabled)

   Active low gate pulse enables SLS/ECHO Thumbwheels (50) to control the level of the applicable SLS pulse if activated by the SLS/ECHO ON/OFF Switch (18). The external SLS output also enables SLS/ECHO Thumbwheels (50) to control level of other pulses in the interrogation when the SLS pulse is deactivated and applicable pulses are set to ***VAR*** in Control Menu #1.

10. DPSK Output (***DI,1st=SEQ*** and/or ***2nd=SEQ***)

    The DPSK output contains the uplink format data information used to modulate the ANT A interrogation signal. The data constantly changes when more than one uplink format is being sent in an interrogation sequence. The first synchronous phase reversal (SPR) occurs 1.25 µs following P_6 leading edge and is transmitted through the DPSK OUT Connector (J10015) (II) to the ATC-1400A.

11. Pulse Power Measurement Gate Output

    The pulse power measurement gate (PPMG) occurs <1.0 µs prior to leading edge of selected pulse in the reply to the first interrogation. The PPMG pulse is transmitted to the ATC-1400A through the MEASUREMENT GATE OUT Connector (J10014) (HH).

    NOTE: The ATC-1400A ignores PPMG if the F_2/P_2 F_1/P_1 Switch (34) is set to ***F_1/P_1***.

12. 50% Video

    The UUT reply video is received through ANT A, the ATC-1400A and the AUXILIARY Connector (J10010) (JJ).

H. BURST Test Function

(1) Description

In the BURST Test Function, the Mode S Test System transmits a certain number of interrogations for a specified time period. The BURST Test Function is used to verify the reply rate capability of the transponder against specifications listed in RTCA DO-181.

(2) Procedure

STEP	PROCEDURE

1. Connect test equipment according to 1-2-4, Figure 24.

2. Apply power to Mode S Test System.

3. Select BURST Test Function. Press 2ND, FUN NO and "7" Keys in sequence or move cursor to ***Func:*** field and press "7" Key.

4. Press CURSOR Key (→) (A) to move cursor to ***BURST,***(Test Function Mode) subfield.

5. Use SLEW Key (F) or press ON/CAL Key as necessary to select test function mode (***ATC***, ***SEQ***, ***ACS*** or ***ACL***).

   NOTE: If Mode S interrogations (***SEQ***) are used, set sequence menus according to Steps 6 and 7, prior to selecting ***SEQ*** as test function mode. If only ATCRBS and All-Call interrogations are used, proceed at Step 8.

6. Press S MENU Key to enter sequence menu.

7. Refer to 1-2-2, Figure 16 and set Mode S interrogation sequence as follows:

   SEQUENCE MENU

   Program sequence menus. With cursor under ***S***(sequence number) field, use SLEW Control (F) to enter each sequence menu. Press ON/CAL Key to activate or deactivate. Activate only desired sequence menus and deactivate all others.

   NOTE: Each Mode S interrogation sequence is a continuation of the previous Mode S interrogation sequence transmitted in BURST Test Function and is reset only by changing test function mode or test function. For example, if ***BURST,SEQ, 3*** is set and five sequence menus are activated, the first interrogation sequence (BURST activated) transmits interrogations programmed by the first three sequence menus. The second interrogation sequence (BURST activated again) transmits interrogations programmed by the fourth, fifth and first sequence menus. Interrogation sequences continue accordingly with each successive BURST activation.

STEP PROCEDURE

FORMAT TYPE

Use SLEW Control (F) or ON/CAL Key to select format type for each active sequence menu. ***FMT D*** displays one of seven defined sequence menus depending on ***UF#*** field. ***FMT S*** displays unspecified short message field (9 octal digits) along with UUT address. ***FMT L*** displays unspecified long message field (28 octal digits) aiong with UUT address. Program short and long message formats according to 1-2-4, Table 5 for testing RTCA DO-181 reply rate requirements.

UPLINK FORMAT NUMBER

Move cursor to ***UF#*** field. Use SLEW Control (F) or Keyboard (B) to select desired uplink format number from ***00*** to ***31*** for unspecified short or long formats. Select UF00, UF04, UF05, UF11, UF16, UF20 or UF21 for defined formats.

DATA FIELDS

Use Keyboard (B) to load data fields according to Appendix E. Refer to 1-2-5D for converting data to octal. Short message fields range from ***0*** to ***777777777***. Long message fields range from ***0*** to ***3777777777777777 777777777777***. Refer to Appendix B for defined fields.

8. Press C MENU and "1" Keys in sequence to enter Control Menu #1.

9. Press CURSOR Key (→) (A) to move cursor to ***BURST,***(BURST Number) subfield. Use Keyboard (B) to enter desired BURST Number (BN). BN selects number of interrogations sent out in single sequence. Set BN according to 1-2-4, Table 5 for testing RTCA DO-181 reply rate requirements.

Reply Rate Test	Message Ratio	BN	PRF
50/sec	2 Shorts/1 Long	***50***	***50***
18/100 ms	2 Shorts/1 Long	***18***	***180***
8/25 ms	1 Short/1 Long	***8***	***400***
4/1.6 ms	1 Short/1 Long	***4***	***2500***

Mode S Reply Rate Testing
Table 5

STEP PROCEDURE

10. Set test parameters as follows:

MODE SELECTION

If test function mode ***ATC***, ***ACS*** or ***ACL*** is selected in Step 5, use XPDR MODE Control (38) to select pulse spacing between P_1 and P_3. Select interrogation mode (***1***, ***2***, ***T***, ***A***, ***B***, ***C*** or ***D***). Select ***AC_2*** for Mode C interrogations when decoded reply in feet is desired on DISPLAY SELECT Readout (43). ***AC_1*** is not used. Mode selected sets one or both interrogations depending on test function modes selected in Step 5.

FREQUENCY

Adjust FREQ/FUNCTION Thumbwheels (45) and ΔF Thumbwheels (48) to set interrogation RF from ***952.01*** to ***1222.99*** MHz. Set to ***1030*** MHz for normal operation.

RF LEVEL

Adjust RF level from -130 to +3 dBm (-69 to -21 dBm is normal operating range) using RF LEVEL -dBm Display (3), RF LEVEL Control (6) and Control Menu #1 ***RFLvl:*** field. Adjust RF LEVEL Control (6) to set RF LEVEL -dBm Display (3) from ***127*** to ***0*** (-127 to 0 dBm). Press RF LVL Key to move cursor to Control Menu #1 ***RFLvl:*** field. Use Keyboard (B) or SLEW Control (F) to set ***RFLvl:*** field from ***-3.0*** to ***+3.0 dB*** to offset cable loss. Press ENT Key to enter selected value.

INTERROGATION RATE

Use PRF/SQTR Thumbwheels (41) to set interrogation rate or PRF from ***0*** to ***2400*** when ***BURST,ATC*** is set. When ***BURST,SEQ*** or ***ACS*** or ***ACL*** is set, PRF settings >***400*** limit BN according to 1-3-1, Table 1. Set PRF according to 1-2-4, Table 5 for testing RTCA DO-181 reply rate requirements.

11. Set pulse characteristics according to test function mode selected.

PULSE WIDTH

Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***CAL*** for 0.8 µs nominal width of P_1, P_2 (if activated) and P_3 (if applicable) interrogation pulses. Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***VAR*** and use XPDR PULSE WIDTH Thumbwheels (49) to adjust width from ***0.20*** to ***1.85*** µs.

P_2 LEVEL (*BURST,SEQ*)

Set SLS/ECHO ON/OFF Switch (18) to ***OFF***. Press 2ND and P2 Keys in sequence to move cursor to Control Menu #1 ***P2:*** field. Press ON/CAL Key to set ***P2:VAR***. Set P_2 level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. 0 dB is normal operating level (***P2:CAL***). When P_2 deactivation is desired, press ON/CAL Key to set ***P2:*** field to ***OFF***.

P_2 POSITION (*BURST,SEQ*)

Set XPDR DEV P_2/CAL Switch (28) to ***CAL*** for nominal P_2 position of 2.0 µs following P_1 leading edge. Set XPDR DEV P_2/CAL Switch (28) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to set position from 0.15 to 3.85 µs following P_1 leading edge.

P_2 (SLS) LEVEL (*BURST,ATC* or *ACS* or *ACL*)

Set SLS/ECHO ON/OFF Switch (18) to ***ON***. Set P_2 (SLS) level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. Verify suppression occurs when P_2 level equals or exceeds P_1 level. Verify suppression does not occur when P_1 level exceeds P_2 level by 9 dB or more.

P_2 (SLS) POSITION (*BURST,ATC* or *ACS* or *ACL*)

Set XPDR DEV P_2/CAL Switch (28) to ***CAL*** for nominal P_2 (SLS) position of 2.0 µs following P_1 leading edge. Set XPDR DEV P_2/CAL Switch (28) to -Δ or +Δ and adjust XPDR P_2/P_3 DEV Thumbwheels (44) from ***0.00*** to ***1.85*** to set position from 0.15 to 3.85 µs following P_1 leading edge.

P_4 LEVEL (*BURST,ACS* or *ACL*)

Set SLS/ECHO ON/OFF Switch (18) to ***OFF***. Press 2ND and P4(P6) Keys in sequence to move cursor to Control Menu #1 ***P4:*** field. Press ON/CAL Key to set ***P4:VAR***. Set P_4 level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. 0 dB is normal operating level (***P4:CAL***). When P_4 deactivation is desired, press ON/CAL Key to set ***P4:OFF***.

P_4 WIDTH (*BURST,ACS* or *ACL*)

P_4 width is adjustable from 0.2 to 2.75 µs for ACS or from 0.2 to 3.55 µs for ACL. Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P4:,Wd=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-0.60*** to ***+1.95*** (time deviated from 0.8 µs in 0.05 µs increments) for ACS or from ***-1.40*** to ***+1.95*** (time deviated from 1.6 µs in 0.05 µs increments) for ACL.

NOTE: When P_4 is set wider than 1.5 µs, ATCRBS Only All-Call becomes ATCRBS/Mode S All-Call. When P_4 is set <1.2 µs, ATCRBS/Mode S All-Call becomes ATCRBS Only All-Call.

P_4 POSITION (*BURST,ACS* or *ACL*)

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P4:,Dv=*** subfield. ***P4:,Dv= CAL*** sets nominal P_4 position at 2.0 µs following leading edge of P_3. P_4 position is adjustable from 0.05 to 3.95 µs following leading edge of P_3. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.95*** to ***+1.95*** (time deviated from 2.0 µs in 0.05 µs increments).

P_5 (SLS) LEVEL (*BURST,SEQ*)

Set SLS/ECHO ON/OFF Switch (18) to ***ON***. Set P_5 (SLS) level using SLS/ECHO Thumbwheels (50). Adjust level from ***-19*** to ***+6*** dB, relative to P_1 level. Verify suppression occurs when P_5 level exceeds P_6 level by 3 dB or more. Verify suppression does not occur when P_6 level exceeds P_5 level by 12 dB or more.

P_5 (SLS) POSITION (*BURST,SEQ*)

P_5 (SLS) position is centered on SPR. Adjusting SPR position changes P_5 position accordingly. Use SLEW Control (F) or Keyboard (B) to set Control Menu #1 ***SPR:,Dv=*** field from ***-1.00*** to ***+1.00*** (time deviated from nominal position in 0.05 µs increments).

P_6 CONTROL (*BURST,SEQ*)

Press 2ND and P4(P6) Keys in sequence to move cursor to Control Menu #1 ***P6:*** field. Press ON/CAL Key to deactivate or activate P_6 pulse.

P_6 WIDTH (*BURST,SEQ*)

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P6:,Wd=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.50*** to ***+1.50*** (time deviated from nominal widths in 0.05 µs increments). Nominal widths are 16.25 µs for 56-bit data field and 30.25 µs for 112-bit data field (Control Menu #1 ***P6:,Wd= CAL***).

P_6 POSITION (*BURST,SEQ*)

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***P6:,Dv=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to select variable value from ***-1.95*** to ***+1.95*** (time deviated from nominal position in 0.05 µs increments). Nominal position is 3.5 µs following P_1 leading edge (control Menu #1 ***P6:,Dv= CAL***).

SPR CONTROL (*BURST,SEQ*)

Press 2ND and SPR Keys in sequence to move cursor to Control Menu #1 ***SPR:*** field. Press ON/CAL Key to deactivate or activate SPR.

SPR POSITION (*BURST,SEQ*)

Use CURSOR Keys (A) to move cursor to Control Menu #1 ***SPR:,Dv=*** subfield. Press ON/CAL Key to select variable value. Use SLEW Control (F) or Keyboard (B) to set variable value from ***-1.00*** to ***+1.00*** (time deviated from nominal position in 0.05 µs increments). Nominal position is 1.25 µs following P_6 leading edge (Control Menu #1 ***SPR:,Dv= CAL***).

STEP PROCEDURE

INTERFERENCE PULSE

Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+***. Interference pulse is activated and positioned at -17.5 to +399.0 µs from leading edge of P_1. Set level from ***-19*** to ***+6*** dB (relative to P_1) using SLS/ECHO Thumbwheels (50). Set width from 0.2 to 5 µs using INTRF PULSE WIDTH Control (31).

SUPPRESSOR PULSE

Connect SUPPRESSOR OUTPUT Connector (16) to UUT suppressor input. Set SUPPRESSOR ON/OFF Switch (17) to ***ON*** to activate suppressor pulse. Adjust level from 3 to 27 V using SUPPRESSOR VAR Adjustment (19). When DBL INTERR/INTRF PULSE Thumbwheels (42) are ***OFF***, suppressor pulse position is 0.8 µs prior to SPR. Activate interference pulse to control position of suppressor pulse (suppressor pulse replaces interference pulse when both are activated). Set DBL INTERR/INTRF PULSE Thumbwheels (42) from ***017.5 INTERF-*** to ***399.0 INTERF+*** to adjust suppressor pulse position from -17.5 to +399.0 µs relative to P_1. Width is fixed at 33 µs.

ANT B

Press 2ND and ANT B Keys in sequence to move cursor to Control Menu #1 ***AntB:*** field. Press ON/CAL Key to activate interrogations through ANT B Connector (E). Use SLEW Control (F) or Keyboard (B) to enter value from ***-0.95*** to ***+0.95*** (offset in 0.05 µs increments from ANT A interrogations).

If Multi-Level Diversity option is installed, set ANT B output level. Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Brf=*** and ***BrfIvl=*** fields. Using SLEW Control (F) or Keyboard (B), set ***Brf=*** field from ***-80*** to ***-20 dBm*** and ***BrfIvl=*** field from ***-3.0*** to ***+3.0 dB*** (used to offset cable loss).

12. If desired, set optional inputs and outputs as follows:

PREPULSE

Press 2ND and P PULS Keys in sequence to move cursor to Control Menu #2 ***Prepulse:*** field. Press ON/CAL Key to activate prepulse through the PREPULSE OUT Connector (EE). Use SLEW Control (F) or Keyboard (B) to enter value from ***0*** to ***260*** (time in microseconds from prepulse leading edge to P_1 leading edge).

NOTE: Prepulse does not operate as specified when activated at the same time as external sync input.

STEP PROCEDURE

EXT SYNC OUTPUT

Press 2ND and EXT SYN Keys in sequence to move cursor to Control Menu #2 ***Ext.Sync.:Out=*** subfield. Press ON/CAL Key to activate external sync pulse through the EXT SYNC OUT Connector (CC). Use SLEW Control (F) or Keyboard (B) to set ***Ext.Sync.:Dv=*** subfield value from ***-9.95*** to ***+9.95*** (time in microseconds from external sync pulse leading edge to P_1 leading edge) (**-**, P_1 follows external sync; **+**, external sync follows P_1).

EXT SYNC INPUT

Use CURSOR Keys (A) to move cursor to Control Menu #2 ***Ext.Sync.:In=*** subfield. Press ON/CAL Key to set EXT SYNC IN Connector (BB) for external sync pulse input. Leading edge of P_1 occurs 7.0 µs after leading edge of external sync pulse. When external sync input is activated, external sync output is deactivated and associated subfields are blank. External sync input controls PRF and is limited same as internal PRF control.

SCOPE TRIGGER OUTPUT

Use T_O/TAC/T_D Switch (30) to set scope trigger output through SCOPE TRIG OUT Connector (AA). Set T_O/TAC/T_D Switch (30) to ***T_O*** for viewing interrogation from GEN Connector (15). Set T_O/TAC/T_D Switch (30) to ***T_D*** for viewing reply from XMTR Connector (12).

NOTE: Connect UUT XMTR Connector (C) to Oscilloscope for viewing UUT replies through ANT B Connector (E).

13. Press BURST Key to activate BURST Test Function.

14. Verify UUT reply information as follows:

PERCENT REPLY

Verify percent reply shown in Control Menu #1 ***%Reply:*** subfields. ***%Reply:ATC=*** subfield displays percent reply for ATCRBS through ANT A. ***%Reply:S=*** subfield displays the percent reply for Mode S through ANT A. ***%Reply:AntB=*** subfield displays the percent reply for ATCRBS and Mode S through ANT B. If Multi-Level Diversity option is installed, ANT B percent reply is also displayed in Control Menu #2 ***AntB%=*** field.

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5. Remote Operation

A. General

Refer to 1-2-2, Figure 6 for S-1403C controls, connectors and indicators (alphabetic characters). Refer to 1-2-2, Figure 17 for ATC-1400A controls, connectors and indicators (numeric characters).

Remote operation of the S-1403C is accomplished through the ATC-1400A IEEE-488 GPIB Connector (53) and internal interface. The external controller activates the ATN line on the ATC-1400A interface, instructing the ATC-1400A to become a talker or listener. The remote operation command, "REM." is sent to the S-1403C over the IFR bus. Upon receipt of the remote operation command, the S-1403C software disables front panel CURSOR Keys (A), Keyboard (B) and SLEW Control (F) operation. The S-1403C responds only to instructions transmitted from an external controller over the GPIB. The MENU Display (I) is deactivated to allow more efficient operation and only the remote operation indication message, ******REMOTE****** is displayed. Issuing one of the display menu commands: "CMENUn." or "SEQN=nn" reactivates the MENU Display (I). When menus are displayed during remote operation, the remote operation indication is not shown. When the MENU Display (I) is activated, GPIB test operation is slower. The MENU Display (I) is only deactivated again by returning to local operation first.

B. Commands

All commands and data are printable ASCII characters.

GPIB commands sent to the S-1403C use delimiters to separate or classify commands. Delimiters used in S-1403C GPIB operation are as follows:

- "=" represents a "set value to" operation.
- "?" represents a "get value" operation.
- "." represents an "enable" operation.
- ";" separates individual "set value to" fields (and same fields in GPIB replies).
- ":" separates individual commands to the S-1403C or ATC-1400A.

Command lines sent to the S-1403C Test Auxiliary must include the prefix "AX3=". Example: AX3=(command 1) : (command 2) :...(command n). GPIB replies from the S-1403C contain the prefix "(space)3:" to set apart S-1403C information strings from ATC-1400A information strings.

NOTE: ATC-1400A commands must precede and be located on a separate line from S-1403C commands. Failure to place commands on separate lines may return false indications.

Error conditions identified in local operation are active in remote operation. Error messages are only sent when requested by the command, "AX3=ERRM?". Valid error messages from the S-1403C cause the ATC-1400A to set bit 1 of the SRQ register. While bit 1 of the SRQ register is active, the command ("AX3=ERRM?") is sent to receive the message and clear the register. If bit 1 of the SRQ register is not set when the command is issued, GPIB reply is "NONE" to indicate no errors.

Command line descriptions contain the following variable fields:

- "__" represents value, data or control entry field.
- "n" represents control menu number or memory location number.
- "nn" represents sequence number.

Entry fields are set to default values or front panel values that were set before switching to remote operation. Loading data into entry fields is optional if change is not desired. Each field preceding the field to be changed is skipped by sending only the field delimiter: e.g. "AX3=P4=;;+1.0" only updates P_4 pulse deviation without changing the preceding level or width control fields.

NOTE: When making program changes (changing modes or interrogation characteristics), wait 100 interrogations before requesting reply information. Use PRF as a guide to how much time to allow.

Remote operation and local operation perform the same functions with the following exceptions:

- Defined uplink and downlink signal formats with fields as shown in Appendix B are not available in GPIB operation. Those formats are programmed over the GPIB using short or long data fields and entering the same data (refer to 1-2-5D).
- MTL testing is only performed through GPIB operation and only if the Multi-Level Diversity/Extended Command Language (MLD/ECL) option is installed.

Commands for when the MLD/ECL option is installed, cause errors when sent to Test Sets without the MLD/ECL option.

NOTE: If Mode S Test Systems with and without the MLD/ECL option are to be used with same GPIB program, use of commands: "AX3=MLDECL?" and "AX3=NEWPB?" are recommended to avoid errors.

For quick reference, GPIB commands are shown in operating order in 1-2-5, Table 6. Detailed explanation of GPIB commands are listed in alphabetical order. All commands are shown separately as executed through the ATC-1400A:

(1) AX3=__

Controls the logic connection between the S-1403C and ATC-1400A (ON [default] or OFF). When set to OFF, the S-1403C simulates being disconnected from the ATC-1400A and may be used in a GPIB program to allow the ATC-1400A to conduct tests independent of the S-1403C.

(2) AX3=ACL.

Enables ACL Test Function (ATCRBS/Mode S All-Call interrogations [long P_4]).

(3) AX3=ACS.

Enables ACS Test Function (ATCRBS Only All-Call interrogations [short P_4]).

(4) AX3=ANTB=__

Controls ANT B interrogation signal position (ANT B Connector [E]). Entry field disables ANT B signal (OFF) or offsets ANT B signal (-1.95 to +1.95, rounded to nearest 0.05 µs) from ANT A signal (RF I/O Connector [9]).

NOTE: Allow one second delay for internal oscillation to stabilize.

(5) AX3=ANTB?

Returns status of ANT B signal position (OFF or -1.95 to +1.95 in microseconds) from ANT A signal.

(6) AX3=APER? (available only with MLD/ECL option installed)

Returns ANT A ATCRBS percent reply (0 to 999).

(7) AX3=ATC.

Enables ATC Test Function (ATCRBS interrogations only).

(8) AX3=BPER? (available only with MLD/ECL option installed)

Returns ANT B percent reply (0 to 999).

(9) AX3=BRF=__ (available only with MLD/ECL option installed)

Sets ANT B attenuation by selecting an output level (20 to 80) in -dBm.

(10) AX3=BRF? (available only with MLD/ECL option installed)

Returns ANT B output level (20 to 80) in -dBm.

(11) AX3=BRFLV=__ (available only with MLD/ECL option installed)

Sets ANT B RF vernier (-3.0 to +3.0) in 0.1 dB increments.

(12) AX3=BRFLV? (available only when MLD/ECL option is installed)

Returns ANT B RF vernier setting (-3.0 to +3.0) in dB.

(13) AX3=BURST=__;__

Enables BURST Test Function. The first entry field selects test function mode (ATC, SEQ, ACS or ACL). Percent reply is tested for the number of interrogations (1 to 999) set in the second entry field (BURST Number [BN]).

(14) AX3=BURST.

Activates BURST Test Function when enabled.

(15) AX3=CMENUn.

Activates MENU Display (I) entering Control Menu #1 (n=1) or #2 (n=2).

NOTE: Test operations over GPIB are slower after initiating this command.

(16) AX3=DFSQnn?

Returns Mode S reply data as received according to sequence menu (nn=1 to 16). Data is returned with type of format (sequence menu is off [F], short data field [S] or long data field [L]), downlink format number in decimal (00 to 31), short (9 octal digits) or long (28 octal digits) data field and transponder address in octal. If no data exists, "NO DATA" message is returned.

(17) AX3=DFSQAnn? (available only with MLD/ECL option installed)

Returns only the transponder address (8 octal digits) received in Mode S reply according to sequence menu (nn=1 to 16).

(18) AX3=DFSQDnn? (available only with MLD/ECL option installed)

Returns only the short (9 octal digits) or long (28 octal digits) downlink data field received in Mode S reply according to sequence menu (nn=1 to 16).

(19) AX3=DFSQFnn? (available only with MLD/ECL option installed)

Returns only the downlink format number in decimal, received in Mode S reply according to sequence menu (nn=1 to 16).

(20) AX3=DFSQTnn? (available only with MLD/ECL option installed)

Returns only the downlink format data type (sequence menu is off [F], short data field [S] or long data field [L]) received in Mode S reply according to sequence menu (nn=1 to 16).

(21) AX3=DI=__;__

Enables Double Interrogation Test Function. Entry fields select first and second interrogation test function modes (ATC, SEQ, ACS or ACL) respectively.

(22) AX3=ERRM?

Returns error status and is used when GPIB controller receives serial poll data indicating auxiliary error (SRQ bit is active). GPIB replies with one of the following error messages:

- "DI/INTF" indicates S-1403C or ATC-1400A (not both) is set for Double Interrogations.
- "INPUT" indicates invalid GPIB command.
- "MODE" indicates ATC-1400A is in DME mode instead of XPDR mode.
- "NONE" indicates no errors.
- "RATE" indicates ATC-1400A PRF setting is above S-1403C test function limitations (refer to 1-3-1). PRF is automatically set to the limitation level.
- "RCVDATA" indicates address parity error.
- "RECALL" indicates an attempt to recall information data ("AX3=RECALLn.") from an empty memory location.

(23) AX3=EXMOD=__

Enables (OFF) or disables (ON) internal ANT A modulation.

(24) AX3=EXMOD?

Returns status of external modulation source. Only external modulation is accepted for ANT A (ON) or both external and internal modulation is accepted for ANT A (OFF).

(25) AX3=EXSYN=__;__;__

Controls external sync output and input. First entry field enables (ON) or disables (OFF) external sync output through EXT SYNC OUT Connector (CC). Second entry field sets external sync pulse output position from -9.95 to +9.95, rounded to nearest 0.05 µs, from rising edge of P_1. Third entry field enables (ON) or disables (OFF) external sync input through EXT SYNC IN Connector (BB). Both external sync output and external sync input cannot be enabled simultaneously.

(26) AX3=EXSYN?

Returns external sync status with current entry field settings.

(27) AX3=INTLCE=__

Enables Interlace Test Function and sets the number (1 to 999) of ATCRBS interrogations for every Mode S interrogation transmitted.

(28) AX3=MLDECL?

Returns status of MLD/ECL option. GPIB reply is "y" (yes, the S-1403 or S-1403C contains the MLD/ECL option) or "n" (no, the S-1403 or S-1403C does not contain the MLD/ECL option). This command is for GPIB programs operating Mode S Test Systems with and without the MLD/ECL option. The GPIB reply to this command is used in the GPIB program to overlook commands that do not apply to the currently operating Mode S Test System.

NOTE: A reply of 3:? indicates an old software version (before 2.0) . Refer to "AX3=VER?" command.

(29) AX3=MODE?

Returns active test function with selected options (ATC, SEQ, ACS, ACL, INTLCE;__, DI;__;__ , or BURST=__;__).

(30) AX3=MTL=__ (available only with MLD/ECL option installed)

Activates the test for measuring minimum triggering level (MTL) of the UUT for the selected test function (ATC, SEQ, ACS or ACL).

NOTE: Test operation time depends on PRF rate and the final MTL RF level.

(31) AX3=MTL? (available only with MLD/ECL option installed)

Returns the MTL value in -dBm for the UUT. MTL is calculated using the following equation:

UUT MTL (RF Level) = Final ATC-1400A RF level - (final S-1403C vernier level - original S-1403C vernier level).

The equation is verified on the RF LEVEL -dBm Display (3) and the MENU Display (I) (RFLvl: field) when activated ("AX3=CMENU1.").

(32) AX3=NEWPB?

Returns Pulse PC Board status. GPIB reply is "y" (yes, the S-1403 or S-1403C contains the new Pulse PC Board or "n" (no, the S-1403 or S-1403C does not contain the new Pulse PC Board). This command is for GPIB programs operating Mode S Test Systems made with old and new S-1403/S-1403C Test Auxiliaries. The GPIB reply to this command is used in the GPIB program to overlook commands that do not apply to the currently operating Mode S Test System.

NOTE: A reply of 3:? indicates an old software version (before 2.0) . Refer to "AX3=VER?" command.

(33) AX3=P2=__

Sets P_2 pulse level when operating in Mode S test functions. Entry field sets pulse level to P_1 (CAL), allows ATC-1400A "ES=" command to set pulse level (VAR) or disables P_2 pulse (OFF).

(34) AX3=P2?

Returns current status of P_2 pulse (CAL, VAR or OFF).

(35) AX3=P3=__

Sets P_3 pulse level when operating in ATCRBS or All-Call test functions. Entry field sets pulse level to P_1 (CAL), allows ATC-1400A "ES=" command to set pulse level (VAR) or disables P_3 pulse (OFF).

(36) AX3=P3?

Returns current status of P_3 pulse (CAL, VAR or OFF).

(37) AX3=P4=__;__;__

Sets P_4 pulse conditions when operating in All-Call test functions. First entry field sets pulse level to P_1 (CAL), allows ATC-1400A "ES=" command to set pulse level (VAR) or disables P_4 pulse (OFF). Second entry field sets pulse width (CAL or 0.20 to 3.55 in microseconds). Third entry field controls pulse position (CAL or -1.95 to +1.95 from CAL, rounded to nearest 0.05 µs.

(38) AX3=P4?

Returns status of P_4 pulse with current entry field settings.

(39) AX3=P6=__;__;__

Sets P_6 pulse conditions when operating in Mode S test functions. First entry field enables or disables P_6 pulse (CAL or OFF). Second entry field sets pulse width (CAL or -1.50 to +1.50 from CAL in 0.05 µs increments). Third entry field controls pulse position (CAL or -1.95 to +1.95 from CAL, rounded to nearest 0.05 µs.

(40) AX3=P6?

Returns status of P_6 pulse with current entry field settings.

(41) AX3=PPMG=__

Sets Pulse Power Measurement Gate (PPMG) control for any pulse in the UUT reply. Entry field disables PPMG (OFF) or selects pulse to be measured for frequency and power. Pulse selection is 1 to 16 for ATCRBS replies and 1 to 116 for Mode S downlink formats.

(42) AX3=PPMG?

Returns PPMG control status.

(43) AX3=PPULSE=__

Sets control for prepulse through the PREPULSE OUT Connector (EE). Entry field disables prepulse (OFF) or sets prepulse position (0 to 260) in microseconds prior to rising edge of P_1.

(44) AX3=PPULSE?

Returns status of prepulse control.

(45) AX3=PRPLY?

Returns percent reply (0 to 999) for ATCRBS (ANT A), Mode S (ANT A) and ANT B.

(46) AX3=RECALLn.

Recalls and activates all S-1403C settings stored in memory location (n =1 or 2). If memory location is empty, bit 1 of the SRQ register is set indicating an error.

(47) AX3=RFLV=__

Sets RF vernier level (-3.0 to +3.0) in 0.1 dB increments.

(48) AX3=RFLV?

Returns current RF vernier level (-3.0 to +3.0) in dB.

(49) AX3=RPDLY?

Returns UUT reply delay in microseconds.

(50) AX3=SAVEn.

Enables S-1403C to store all current settings in memory location (n=1 or 2).

NOTE: Only S-1403C settings (not ATC-1400A settings) are stored.

(51) AX3=SEQ.

Enables SEQ Test Function (Mode S interrogations only).

(52) AX3=SEQN=nn

Activates MENU Display (I) by entering the sequence menu selected (nn=1 to 16).

NOTE: Test operations over GPIB are slower after initiating this command.

(53) AX3=SPER? (available only with MLD/ECL option installed)

Returns percent reply (0 to 999) for Mode S (ANT A) only.

(54) AX3=SPR=__;__

Controls SPR in Mode S test functions. First entry field enables (ON) or disables SPR (OFF). Second entry field controls SPR position (CAL or -1.00 to +1.00 from CAL, rounded to nearest 0.05 µs).

(55) AX3=SPR?

Returns current status of SPR.

(56) AX3=SQnn=__;__;__;__

Programs sequence menu (nn=1 to 16). Entry fields set format type (sequence menu off [F], short data field [S] or long data field [L]), uplink format number in decimal (00 to 31), short (9 octal digits) or long (28 octal digits) data field and UUT address in octal. Refer to 1-2-5D for programming data fields.

NOTE: Program sequence menus prior to operating in desired Mode S test function. Refer to 1-2-5, Table 7 for program timing.

(57) AX3=SQnn?

Returns status of sequence menu (nn=1 to 16) showing entry field settings.

(58) AX3=SQADD?

Returns the octal conversion of the UUT address received in latest squitter.

(59) AX3=SQTR?

Returns UUT squitter period (0.00 to 9.99) in seconds.

(60) AX3=STATMTL? (available only with MLD/ECL option installed)

Returns status of MTL test. GPIB reply possibilities are:

- "BUSY" indicates MTL test in progress.
- "DONE" indicates MTL test is complete and successful (UUT passed).
- "ERR1" indicates MTL = -69 dBm and percent reply is <98.
- "ERR2" indicates MTL = -84 dBm and percent reply is >10.
- "ERR3" indicates MTL is >-69 dBm.
- "ERR4" indicates MTL is <-84 dBm.
- "ERR5" indicates excessive percent reply variation.

NOTE: Initiate this command at greater than half-second intervals for minimal MTL acquisition time.

(61) AX3=VER?

Returns Main Processor and Front Panel Processor software versions. GPIB reply is "mm.mm;ff.ff", where mm.mm is the Main Processor software version number and ff.ff is the Front Panel Processor software version number.

NOTE: A reply of 3:? indicates an old software version (before 1.5).

COMMAND	RANGE/VALUES	DEFINITION
AX3=__	ON or OFF	Sets logic connection to ATC-1400A.
AX3=VER?	mm.mm;ff.ff (00.00 to 99.99)	Get Main (mm.mm) and Front Panel (ff.ff) CPU software version numbers.
AX3=NEWPB?	y (yes) or n (no)	Find whether or not the new Pulse PC Board is installed.
AX3=MLDECL?	y (yes) or n (no)	Find whether or not the MLD/ECL option is installed.
AX3=ATC.	No range or value	Enable ATC Test Function.
AX3=SEQ.	No range or value	Enable SEQ Test function.
AX3=ACS.	No range or value	Enable ACS Test function.
AX3=ACL.	No range or value	Enable ACL Test Function.
AX3=INTLCE=_	1 to 999	Enable INTLCE Test Function and sets Mode S to ATCRBS ratio.
AX3=DI=_;_	ATC/ACS/ACL/SEQ; ATC/ACS/ACL/SEQ	Enable DI Test Function and sets type of interrogations.
AX3=BURST=_;_	ATC/ACS/ACL/SEQ; 1 to 999	Enable BURST Test Function, setting type and number of interrogations.
AX3=BURST.	No range or value	Activate BURST Test Function.
AX3=MODE?	ATC/SEQ/ACS/ACL/ INTLCE;_/DI;_;_/BURST;_;_	Get current test function settings.
AX3=RFLV=_	-3.0 to +3.0	Set ANT A RF vernier level (dB).
AX3=RFLV?	-3.0 to +3.0	Get ANT A RF vernier level (dB).
AX3=P4=_;_;_	CAL/VAR/OFF; CAL/0.20 to 3.20; CAL/-1.95 to +1.95	Set P_4 (ACS/ACL) pulse level control, width and position.
AX3=P4?	CAL/VAR/OFF; CAL/0.20 to 3.20; CAL/-1.95 to +1.95	Get status of P_4 pulse.
AX3=P6=_;_;_	CAL/OFF; CAL/-1.50 to +1.50; CAL/-1.95 to +1.95	Activate and set P_6 (SEQ) pulse level, width and position.
AX3=P6?	CAL/OFF; CAL/-1.50 to +1.50; CAL/-1.95 to +1.95	Get status of P_6 pulse.
AX3=P2=_	CAL/VAR/OFF	Set P_2 level control
AX3=P2?	CAL/VAR/OFF	Get P_2 level control status.
AX3=P3=_	CAL/VAR/OFF	Set P_3 level control.

S-1403C GPIB Command List
Table 6

COMMAND	RANGE/VALUES	DEFINITION
AX3=P3?	CAL/VAR/OFF	Get P_3 level control status.
AX3=SPR=_;_	ON/OFF; CAL/-1.00 to +1.00	Activate and set SPR position.
AX3=SPR?	ON/OFF; CAL/-1.00 to +1.00	Get SPR status.
AX3=RPDLY?	000.000 to 399.000	Get UUT reply delay (µs).
AX3=SQTR?	0.00 to 9.99	Get UUT squitter period (seconds).
AX3=PRPLY?	0 to 999; 0 to 999; 0 to 999	Get UUT % reply for ANT A ATCRBS, ANT A Mode S and ANT B.
AX3=APER?	0 to 999	Get UUT ANT A ATCRBS % reply.-**MLD/ECL**
AX3=SPER?	0 to 999	Get UUT ANT A Mode S % reply.-**MLD/ECL**
AX3=BPER?	0 to 999	Get UUT ANT B % reply.-**MLD/ECL**
AX3=ANTB=_	OFF/-0.95 to +0.95	Activate ANT B (µs from ANT A).
AX3=ANTB?	OFF/-0.95 to +0.95	Get ANT B status.
AX3=SQADD?	00000000 to 77777777	Get squitter address.
AX3=PPULSE=_	0 to 260/OFF	Activate prepulse (µs prior to P_1).
AX3=PPULSE?	0 to 260/OFF	Get prepulse status.
AX3= EXSYN=_;_;_	ON/OFF; -9.95 to +9.95 ON/OFF	Activate Ext Sync output and set Ext Sync output position (µs from P_1) or activate Ext Sync Input.
AX3=EXSYN?	ON/OFF; -9.95 to +9.95 ON/OFF	Get Ext Sync output and input status.
AX3=PPMG=_	OFF/1 to 16 (ATCRBS) or OFF/1 to 116 (Mode S)	Set PPMG control for any reply pulse.
AX3=PPMG?	OFF/1 to 16 (ATCRBS) or OFF/1 to 116 (Mode S)	Get PPMG control status.
AX3=EXMOD=_	ON/OFF	Set ANT A for Ext Mod input only.
AX3=EXMOD?	ON/OFF	Get Ext Mod input only status.
AX3=BRF=_	20 to 80	Set ANT B output (-dBm).-**MLD/ECL**
AX3=BRF?	20 to 80	Get ANT B output (-dBm).-**MLD/ECL**
AX3=BRFLV=_	-3.0 to +3.0	Set ANT B RF vernier level (dB).-**MLD/ECL**

S-1403C GPIB Command List
Table 6 (Cont)

COMMAND	RANGE/VALUES	DEFINITION
AX3=BRFLV?	-3.0 to +3.0	Get ANT B RF vernier level (dB). -**MLD/ECL**
AX3= SQnn=_;_;_;_	nn=1 to 16; F/S/L; 00 to 31; 0 to 777777777 (short)/0 to 37777777777777777777 77777(long); 0 to 77777777	Program Sequence Menu (1 to 16).
AX3=SQnn?	nn=1 to 16; F/S/L; 00 to 31; 0 to 777777777 (short)/0 to 37777777777777777777 77777 (long); 0 to 77777777	Get Sequence Menu (1 to 16) status.
AX3=DFSQnn?	nn=1 to 16; F/S/L; 00 to 31; 0 to 777777777 (short)/ 0 to 37777777777777777777 77777 (long); 0 to 77777777	Get downlink format data for Sequence Menu (1 to 16).
AX3=DFSQTnn?	nn=1 to 16; F/S/L	Get downlink format type for Sequence Menu (1 to 16).-**MLD/ECL**
AX3=DFSQFnn?	nn=1 to 16; 00 to 31	Get downlink format number for Sequence Menu (1 to 16).-**MLD/ECL**
AX3=DFSQDnn?	nn=1 to 16; 0 to 777777777 (short)/ 0 to 3777777777777 777777777777777 (long)	Get downlink format data for Sequence Menu (1 to 16).-**MLD/ECL**
AX3=DFSQAnn?	nn=1 to 16; 0 to 77777777	Get downlink format address for Sequence Menu (1 to 16).-**MLD/ECL**
AX3=SAVEn	n=1 or 2	Store current S-1403C settings.
AX3=RECALLn	n=1 or 2	Recall S-1403C stored settings.
AX3=SEQN=nn	1 to 16 (decimal)	Activate MENU Display (I) with Sequence Menu (1 to 16).
AX3=CMENUn.	n=1 or 2	Activate MENU Display (I) with Control Menu (1 or 2).
AX3=ERRM?	DI/INTF or INPUT or MODE or NONE or RATE or RCVDATA or RECALL	Get error status.
AX3=MTL=_	ATC/SEQ/ACS/ACL	Start MTL test.-**MLD/ECL**
AX3=STATMTL?	BUSY/DONE/ERR1 to ERR5	Get MTL test status.-**MLD/ECL**
AX3=MTL?	60.0 to 90.0	Get UUT MTL (-dBm).-**MLD/ECL**
-MLD/ECL	Indicates GPIB command applies only with MLD/ECL option installed.	

S-1403C GPIB Command List
Table 6 (Cont)

C. Programming Time

Timing is important for consistent GPIB program operation. Refer to 1-2-5, Table 7 for GPIB timing information.

MODE	PROGRAM TIMING	
ATC	60 ms	
SEQ	85 ms for 1 short	
	98 ms for 1 long	
	128 ms for 2: 1 long, 1 short	
	159 ms for 3: 1 long, 2 short	
	201 ms for 4: 2 long, 2 short	
	140 ms for 2 long	
	117 ms for 2 short	
ACS or ACL	60 ms	
BURST	ATC	59 ms
	SEQ with PRF <400	116 ms for 2 short
		139 ms for 2 long
	SEQ with PRF >400	138 ms for 1 long 1150 PRF
		138 ms for 1 long 2250 PRF
		168 ms for 2 long 2250 PRF

NOTE: Estimate 55 ms for entering routine.
Estimate 31 ms to program each short.
Estimate 42 ms to program each long.

NOTE: Add GPIB overhead (variable depending on ATC-1400A and S-1403C).

NOTE: Allow 1 second delay for internal oscillator to stabilize when using ANT B command (AX3=ANTB=__).

NOTE: Increase time allowed for MTL and reply delay commands as PRF is decreased.

GPIB Program Timing Table
Table 7

D. GPIB Examples

(1) Example #1: Send Uplink Format 05 (Short Format) in Sequence Menu S01.

Example transponder address: 17725762.

Example data field settings (Refer to Appendix E.):

FIELD	SETTING DEFINITION
PC	Data being sent is for information only.
RR	Request identification of aircraft being interrogated.
DI	SD field contains multisite information.
SD	Field is composed of subfields IIS, MBS, LOS, RSS and TMS.
IIS	Interrogator identification.
MBS	Reserve COMM-B for use.
MES	Close out COMM-C and COMM-D from use.
LOS	Lockout field listed in IIS, from further All-Call interrogations. Continue to acknowledge other All-Call requests.
RSS	No request for field UM (not used).
TMS	Unlinked Message/Request, acknowledge receipt.

Binary representation of the 27 example data field bits:

100 PC	10010 RR	001 DI	0100 IIS	01 MBS	111 MES	1 LOS	00 RSS	0010 TMS
			SD					

To convert the binary representation to nine octal digits, refer to 1-2-5, Table 8 and make a table similar to the following:

BINARY	100	100	100	010	100	011	111	000	010
OCTAL	4	4	4	2	4	3	7	0	2

Set Example #1 GPIB command as follows:

COMMAND	DEFINITION
AX3=	Command instructs S-1403C to transfer command of tests to be conducted from the Front Panel to GPIB.
SQ1	Sequence Menu #01.
S	Short data field length.
05	Uplink Format 05 (decimal).
444243702	Nine-digit (octal) data field.
17725762	Eight-digit (octal) transponder address.
GPIB Command : AX3=SQ01;S;05;444243702;17725762.	

BINARY	OCTAL	DECIMAL	HEXADECIMAL
000	0	0	0
001	1	1	1
010	2	2	2
011	3	3	3
100	4	4	4
101	5	5	5
110	6	6	6
111	7	7	7
1000	10	8	8
1001	11	9	9
1010	12	10	A
1011	13	11	B
1100	14	12	C
1101	15	13	D
1110	16	14	E
1111	17	15	F

Number Systems Conversion
Table 8

(2) Example #2: Send Uplink Format 21 (Long Format) in Sequence Menu S02.

Example transponder address: 17725762.

Example data field settings (Refer to Appendix E.):

FIELD	SETTING DEFINITION
PC	Non-selective All-Call lockout.
RR	Identification of aircraft being interrogated.
DI	Notice to expect extended information.
SD	Field is composed of subfields IIS, RRS, LOS and TMS.
IIS	Interrogator Identification.
RRS	Transmit reply in extended format.
LOS	Lockout all All-Call responses.
TMS	Linked first segment, multiple addresses, priority individual call, acknowledge.
MA	Field is composed of subfields ADS and message.
ADS	Extended message immediately follows.
*	Data bits not used in uplink format message.

Binary representation of the 83 example data field bits:

001 PC	10010 RR	111 DI	0100 IIS	0101 RRS	0 *	1 LOS	00 *	1011 TMS	01011100 ADS	48-Zeros Message
			SD						MA	

To convert the binary representation to 28 octal digits, refer to 1-2-5, Table 8 and make a table similar to the following (first octal digit carries only two bits [maximum value of 3]):

BINARY	00	110	010	111	010	001	010	100	101	101
OCTAL	0	6	2	7	2	1	2	4	5	5
BINARY		011	100	000	000	000	000	000	000	000
OCTAL		3	4	0	0	0	0	0	0	0
BINARY		000	000	000	000	000	000	000	000	000
OCTAL		0	0	0	0	0	0	0	0	0

Set Example #2 GPIB command as follows:

COMMAND	DEFINITION
AX3=	Command instructs S-1403C to transfer command of tests from Front Panel control to GPIB.
SQ2	Sequence Menu #02.
L	Long data field length.
21	Uplink Format 21 (decimal).
0627...000	28-digit (octal) data field.
17725762	Eight-digit (octal) transponder address.
GPIB Command : AX3=SQ02;L;21;06272124553400000000000000000;17725762	

(3) Example #3: Receive Downlink Format 04 (Altitude Reply).

Example transponder address: 17725762

GPIB command: "AX3=DFSQnn?" (nn=2 [default Sequence Menu S02] or 1 to 16 [any active sequence menu programmed for UF04])

GPIB return: " 3:S;4;2035;17725762"

RESPONSE	DEFINITION
3	Indicates GPIB reply is from the S-1403C.
S	Short Format.
4	Downlink Format 04.
2035	Octal Data Field.
17725762	Example Transponder Address.

Convert the four octal digits to decimal altitude in feet. Proceed as follows:

STEP PROCEDURE

1. Refer to 1-2-5, Table 8 and convert the octal data field digits to binary using the following format:

C_1	A_1	C_2	A_2	C_4	A_4	X	B_1	D_1	B_2	D_2	B_4	D_4
B10	B9	B8	B7	B6	B5	M	B4	Q	B3	B2	B1	B0
0	0	1	0	0	0	0	0	1	1	1	0	1
0	2			0			3			5		

NOTE: Refer to Appendix E for breakdown of individual data fields. The AC field contains the last 13 bits shown in the above grid. The GPIB reply indicates no active bits for the FS, DR and UM fields.

If bit position Q (d1) is 0, go to Step 7 for altitude readout.

BINARY ALTITUDE CODE (Q=1)

2. Discard bit positions M and Q.

3. Separate bits into three fields and convert to hexadecimal as follows (refer to 1-2-5, Table 8):

B10	B9	B8
0	0	1
1		

B7	B6	B5	B4
0	0	0	0
0			

B3	B2	B1	B0
1	1	0	1
D			

STEP PROCEDURE

4. Convert the 3-digit (hexidecimal) altitude code to decimal code.

   10D = 269 ([1 x 256 = 256] + [0 x 16 = 0] + 13)

5. Multiply decimal number by 25.

   269 X 25 = 6725

6. Subtract 1000 from the answer in Step 5.

   6725 - 1000 = 5725 feet

   This altitude should agree with answer shown in the AC= field of Sequence Menu S02 (or sequence menu with UF04 active). Activate MENU Display (I) with command ("AX3=SQN=nn"), entering applicable sequence menu number.

   MODE C ALTITUDE CODE (Q=0) (Example field changed to 2015.)

7. Discard bit positions X and D_1.

8. Rearrange data bits using the following format:

D_2	D_4	A_1	A_2	A_4	B_1	B_2	B_4	C_1	C_2	C_4
1	1	0	0	0	0	1	0	0	1	0

9. Refer to ATC-1400A Operation Manual for conversion to altitude (Altitude Transmission Code Chart).

   Example field translates to 64,500 feet.

(4) Example #4: Receive Downlink Format 05 (Identification Reply).

Example transponder address: 17725762

GPIB command: "AX3=DFSQnn?", (nn=3 [default Sequence Menu S03] or 1 to 16 [any active sequence menu programmed for UF05])

GPIB return " 3:S;5;11026;17725762"

RESPONSE	DEFINITION
3	Indicates GPIB reply is from the S-1403C.
S	Short Format.
5	Downlink Format 05.
11026	Octal Data Field.
17725762	Example Transponder Address.

Convert the five octal digits to ID code (four octal digits). Proceed as follows:

STEP PROCEDURE

1. Refer to 1-2-5, Table 8 and convert octal digits to binary:

C_1	A_1	C_2	A_2	C_4	A_4	X	B_1	D_1	B_2	D_2	B_4	D_4
1	0	0	1	0	0	0	0	1	0	1	1	0
1	1			0			2			6		

NOTE: Refer to Appendix E for breakdown of individual data fields. The ID field contains the last 13 bits shown in the above grid. The GPIB reply indicates no active bits for the FS, DR and UM fields.

2. Rearrange binary bits to the following format, discarding bit position X:

A_4	A_2	A_1	B_4	B_2	B_1	C_4	C_2	C_1	D_4	D_2	D_1
0	1	0	1	0	0	0	0	1	0	1	1

3. Refer to 1-2-5, Table 8 and convert the binary bits to octal:

0	1	0	1	0	0	0	0	1	0	1	1
2			4			1			3		

This identification code should agree with answer shown in the ID= field of Sequence Menu S03 (or sequence menu with UF05 active). Activate MENU Display (I) with command: "AX3=SQN=nn", entering applicable sequence menu number.

SECTION 3 - SPECIFICATIONS

1. Mode S Test System Specifications

NOTE: These specifications supersede ATC-1400A Specifications when the ATC-1400A is connected with the S-1403C. Refer to 1-3-1 in the ATC-1400A Operation Manual for specifications not outlined in this section.

A. RF

(1) Antenna A (ANT A), RF I/O Connector

Frequency: Per ATC-1400A Specifications

Level: Per ATC-1400A Specifications

Vernier Control:

Range: ±3.0 dB

Step: 0.1 dB

Accuracy: ±10%

(2) Antenna B (ANT B), ANT B Connector

Frequency: 1030 MHz

Accuracy: 0.001%

Level:

Range: -50 dBm (without MLD)
-20 to -80 dBm (with MLD)

Step: 1 dB (with MLD)

Accuracy: ±1 dB relative to ATC-1400A at -50 dBm (without MLD)
±0.5 dB relative to ATC-1400A at -20 dBm (with MLD)

Attenuator Accuracy: (with MLD)

LEVEL	ACCURACY
30 dBm	±0.4 dB
40 dBm	±0.4 dB
50 dBm	±0.4 dB
60 dBm	±0.5 dB
70 dBm	±0.61 dB
80 dBm	±0.72 dB

Vernier Control:

Range:	±3.0 dB
Step:	0.1 dB
Accuracy:	±0.05 dB or 10%

B. Pulse Characteristics

NOTE: Pulse characteristics are verified from the RF I/O or ANT B Connectors using a Heterodyne Monitor.

(1) General

ANT A

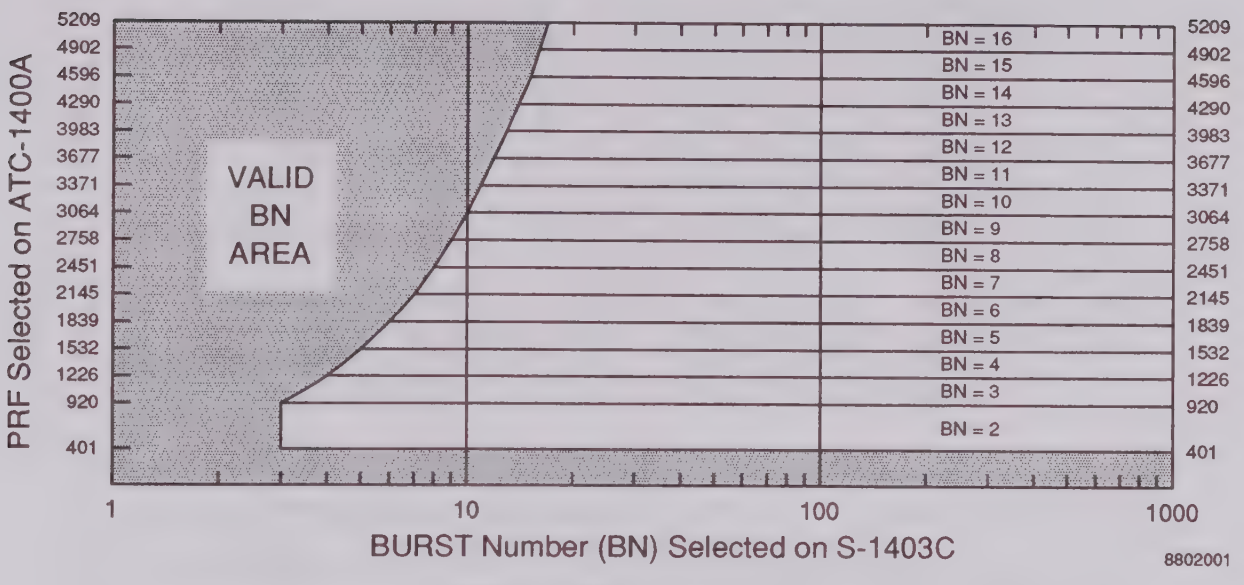
Rise and Fall times:	Per ATC-1400A Specifications

ANT B

Rise Time:	50 to 90 ns
Fall Time:	50 to 200 ns
On/Off Ratio:	>80 dB
P_1 Position (CAL):	Relative to ANT A P_1
Deviation:	Variable from CAL (±0.95 µs)
Step:	0.05 µs
ANT A to ANT B Tracking Accuracy:	±25 ns

PRF Limitations:

ATC Test Function:	2400
SEQ Test Function:	200
ACS Test Function:	2400
ACL Test Function:	200
INTLCE Test Function:	900 (1:≥5) 800 (1:4) 600 (1:3) 400 (1:2) 200 (1:1)
DI Test Function:	750 (ATC;ATC) 100 (All others)



BURST Number Reduction
Figure 1

BURST Test Function: 2400 (ATC)
≤5209 (All others) Refer to 1-3-1, Figure 1. PRF limitation causes BURST Number (BN) Reduction and is computed using the following equation:

BN = [Integer value of (0.00326 • PRF)]. BN is never reduced to <2.

(2) ATC Test Function

P_2 SLS:

Amplitude (CAL) (ANT A): 0 dB, relative to P_1

Range: Variable from -19 to +6 dB

Step: 1 dB

Accuracy: ±0.3 dB for -10 to +3 dB

Width (CAL)
(ANT A and ANT B): 0.8 µs

Range: Variable from 0.2 to 1.85 µs

Step: 0.05 µs

Accuracy: ±10 ns

Position (CAL) (ANT A and ANT B):	2.0 µs following leading edge of P_1
Deviation:	Variable from CAL (±1.85 µs)
Step:	0.05 µs
Accuracy:	±10 ns

P_3:

Amplitude (CAL) (ANT A):	0 dB, relative to P_1
Range:	Variable from -19 to +6 dB
Step:	1 dB
Accuracy:	±0.3 dB for -10 to +3 dB
Width (CAL) (ANT A and ANT B):	0.8 µs
Range:	Variable from 0.20 to 1.85 µs
Step:	0.05 µs
Accuracy:	±10 ns
Position (CAL) (P_1 to P_3):	3.0 µs ±10 ns (Mode 1) 5.0 µs ±10 ns (Mode 2) 6.5 µs ±10 ns (Mode T) 8.0 µs ±10 ns (Mode 3/A) 17.0 µs ±10 ns (Mode B) 21.0 µs ±10 ns (Mode C) 25.0 µs ±10 ns (Mode D)
Deviation:	Variable from CAL (±1.85 µs)
Step:	0.05 µs
Accuracy:	±10 ns

Interference Pulse:

Amplitude:	0 dB, relative to P_1
Range:	Variable from -19 to +6 dB
Step:	1 dB
Accuracy:	±0.3 dB for -10 to +3 dB
Width:	Variable from 0.2 to 5 µs

Position: Variable from 17.5 µs prior to P_1 to 399 µs following P_1

Step: 0.1 µs

Accuracy: ±0.05 µs ±0.005% of pulse position selected on the ATC-1400A

Suppressor Pulse: Per ATC-1400A Specifications

Prepulse through PREPULSE OUT Connector:

Position: Variable from 0 to 260 µs prior to leading edge of P_1

Step: 1 µs

Accuracy: ±50 ns

External Sync Output through EXT SYNC OUT Connector:

Position: Variable from -9.95 to +9.95 µs from rising edge of P_1

Step: 0.05 µs

Accuracy: ±50 ns

Mode S/$\overline{\text{ATCRBS}}$ Discrete Pulse through MODE S/ATCRBS DISCRETE OUT Connector:

Width: 3.0 µs

Accuracy: ±50 ns

Position: 1.0 µs prior to leading edge of P_1

Accuracy: ±50 ns

(3) SEQ Test Function

P_2:

P_2 Amplitude (CAL) (ANT A): 0 dB, relative to P_1

Range: Variable from -19 to +6 dB

Step: 1 dB

Accuracy: ±0.3 dB for -10 to +3 dB

Width (CAL) (ANT A and ANT B):	0.8 µs
Range:	Variable from 0.20 to 1.85 µs
Step:	0.05 µs
Accuracy:	±10 ns
Position (CAL) (ANT A and ANT B):	2.0 µs following leading edge of P_1
Deviation:	Variable from CAL (±1.85 µs)
Step:	0.05 µs
Accuracy:	±10 ns

P_5 SLS:

Amplitude (CAL) (ANT A):	0 dB, relative to P_1
Range:	Variable from -19 to +6 dB
Step:	1 dB
Accuracy:	±0.3 dB for -10 to +3 dB
Width (CAL) (ANT A and ANT B):	0.8 µs
Accuracy:	±100 ns
Position (CAL) (ANT A and ANT B):	0.4 µs before Sync Phase Reversal (SPR)
Deviation:	Controlled by SPR deviation
Accuracy:	±100 ns

P_6 (ANT A and ANT B):

Amplitude (CAL):	0 dB, relative to P_1
Width (CAL):	16.25 µs for short formats 30.25 µs for long formats
Range:	Variable from CAL (±1.5 µs)
Step:	0.05 µs
Accuracy:	±10 ns

Position (CAL):	3.5 µs following leading edge of P_1
Deviation:	Variable from CAL (±1.95 µs)
Step:	0.05 µs
Accuracy:	±10 ns
SPR (ANT A and ANT B):	
Position (CAL):	2.75 µs following leading edge of P_2 (CAL)
Deviation:	Variable from CAL (±1 µs) (DPSK data deviates accordingly.)
Step:	0.05 µs
Accuracy:	±10 ns
DPSK:	
Output Phase Signal:	Switching >1.2 V_{P-P} centered at 0 Vdc (bipolar) into 50 Ω
Phase Reversal Time:	<80 ns (10° to 170°)
Interference Pulse:	Same as in ATC Test Function
Suppressor Pulse:	
Position:	0.8 µs prior to SPR (CAL)
Accuracy:	±100 ns
Prepulse:	Same as ATC Test Function
External Sync Output:	Same as ATC Test Function

(4) ACS/ACL Test Functions

P_2 SLS:	Same as in ATC Test Function
P_3 (ANT A and ANT B):	Same as in ATC Test Function
P_4:	
Amplitude (CAL) (ANT A):	0 dB, relative to P_1
Range:	Variable from -19 to +6 dB
Step:	1 dB
Accuracy:	±0.3 dB for -10 to +3 dB

Width (CAL) (ANT A and ANT B):	0.8 µs for short P_4 (ACS) or 1.6 µs for long P_4 (ACL)
Range:	Variable (independent of P_1, P_2 and P_3) from 0.2 µs to 2.75 µs for short P_4 (ACS) or from 0.2 µs to 3.55 µs for long P_4 (ACL)
Step:	0.05 µs
Accuracy:	±10 ns
Position (CAL):	2.0 µs following leading edge of P_3
Deviation:	Variable from CAL (±1.95 µs)
Step:	0.05 µs
Accuracy:	±10 ns
Interference Pulse:	Same as in ATC Test Function
Suppressor Pulse:	
Position:	0.8 µs prior to leading edge of P_3
Accuracy:	±100 ns
Prepulse:	Same as Prepulse in ATC Test Function
External Sync Output:	Same as External Sync Output in ATC Test Function

(5) INTLCE Test Function:

ATC Interrogations:	Same as ATC Test Function (CAL settings)
SEQ Interrogations:	Same as SEQ Test Function (CAL settings)
Position:	200 µs from ATC interrogation P_1 leading edge to SEQ interrogation P_1 leading edge
Accuracy:	±10 ns

(6) DI Test Function:

First Interrogation:	Refer to applicable test function.
DI Spacing:	Per ATC-1400A Specifications
Second Interrogation:	Refer to applicable test function (CAL settings).

(7) BURST Test Function: Refer to applicable test function.

C. UUT Measurements

Reply Delay:

ATCRBS (ATC) (from leading edge of P_3 [CAL] to leading edge of F_1):

Range:	2 to 4 µs
Resolution:	25 ns
Accuracy:	±100 ns

Mode S (SEQ) (from SPR to leading edge of reply pulse P_1):

Range:	126 to 130 µs
Resolution:	25 ns
Accuracy:	±50 ns

%Reply:

ANT A (ATCRBS valid reply):

Range:	0 to 127%
Resolution:	1%
Accuracy:	±1 step

ANT A (Mode S valid reply):

Range:	0 to 127%
Resolution:	1%
Accuracy:	±1 step

ANT B (composite-ATCRBS and Mode S valid replies):

Range:	0 to 127%
Resolution:	1%
Accuracy:	±1 step

Squitter Period:

Period:

Range:	0.00 to 9.99 seconds
Resolution:	10 ms
Accuracy:	±10 ms
Address Range:	0 to 2^{24} - 1

D. Power

Input (ac):

Voltage:	105 to 120/220 to 250 VAC
Frequency:	50 to 400 Hz
Power Consumption:	≤350 W (40 W [S-1403C] + ac Output power)
Output (ac):	Line output, fused at 3 Amps and switched

SECTION 4 - SHIPPING

1. General

The following information applies to shipping and repacking procedures for the Test Set.

A. Shipping Information

IFR Test Sets returned to factory for calibration, service or repair must be repackaged and shipped subject to the following conditions:

(1) Authorization

Do not return products to factory without authorization from IFR Customer Service Department.

CONTACT: IFR Systems, Inc.
Customer Service Dept.
10200 West York Street
Wichita, Kansas 67215

Telephone: 800-835-2350
TWX: 910-741-6952

(2) Tagging Test Sets

All test sets must be tagged with:

- Owner's identification and address.
- Nature of service or repair required.
- Model No.
- Serial No.

(3) Shipping Containers

Test Sets must be repackaged in original shipping containers using IFR packing molds. If original shipping containers and materials are not available, contact IFR Customer Service Dept. for shipping instructions.

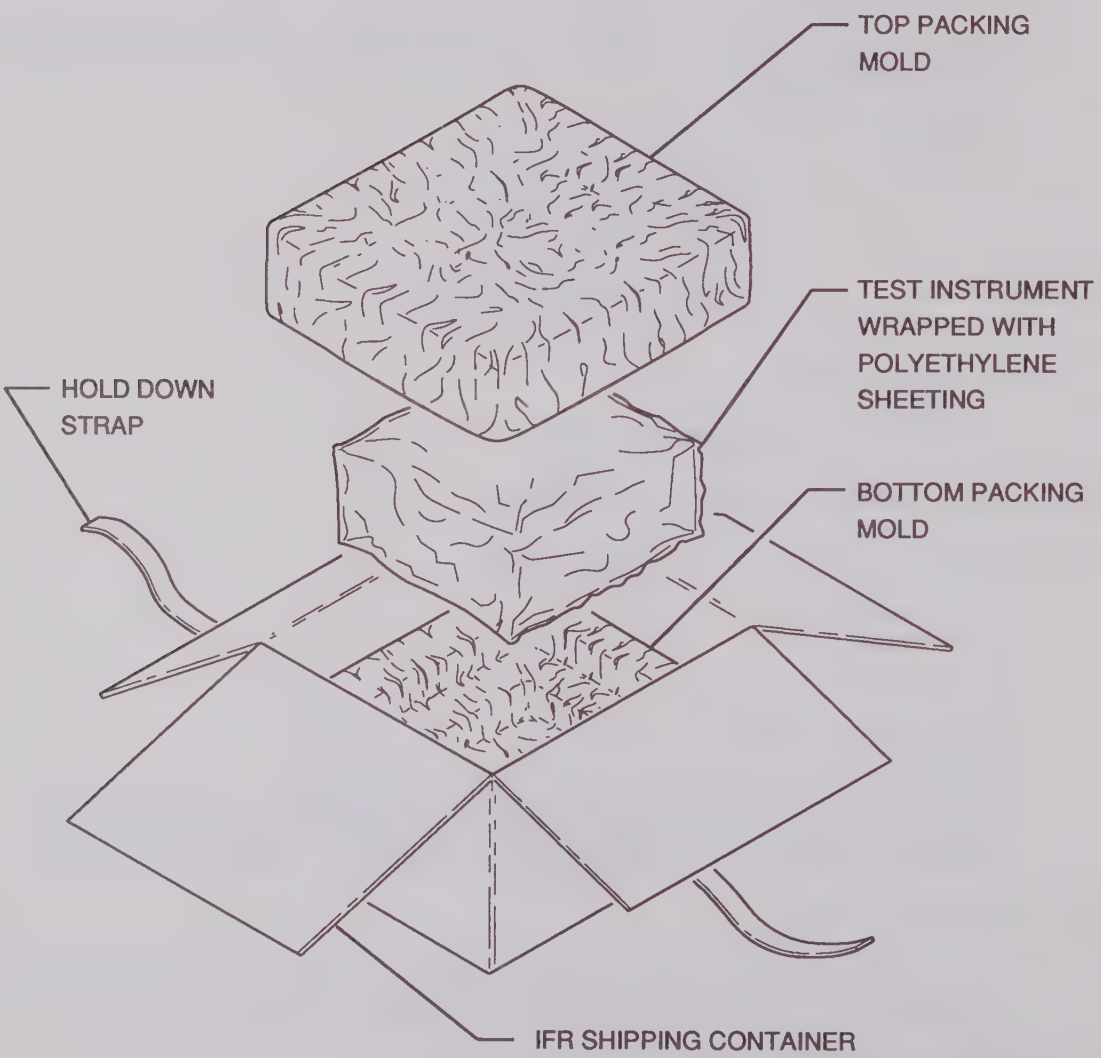
(4) Freight Costs

All freight costs on non-warranty shipments are assumed by customer. (See "Warranty Packet" for freight charge policy on warranty claims.)

B. Repacking Procedure (Refer to 1-4-1, Figure 1.)

- Make sure bottom packing mold is seated on floor of shipping container.
- Carefully wrap Test Set with polyethylene sheeting to protect finish.

- Place Test Set into shipping container, making sure Test Set is securely seated in bottom packing mold.
- Place top packing mold over top of Test Set and press down until mold rests solidly in bottom packing mold.
- Close shipping container lids and seal with shipping tape or an industrial stapler. Tie all sides of container with break resistant rope, twine or equivalent.



Repacking Procedure
Figure 1

SECTION 5 - STORAGE

1. General

The following storage precautions should be accomplished whenever Test Set is stored for extended periods:

- Disconnect Test Set from power source.
- Disconnect and store ac power cable and accessories with Test Set.
- Cover Test Set to prevent dust and debris from covering and entering Test Set.

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APPENDIX A - CONNECTOR PIN-OUT TABLES

1. Table of S-1403C I/O Connectors

CONNECTOR	SIGNAL NAME	SIGNAL TYPE	INPUT/OUTPUT
FRONT PANEL			
J10001	UUT XMTR	50 Ω	OUTPUT
J10002	ANT B	50 Ω	INPUT/OUTPUT
PULSE PC BOARD ASSEMBLY			
J10003	EXT MOD	TTL	INPUT
J10004	EXT SYNC	TTL	INPUT
J10005	ATCRBS DISC	TTL	OUTPUT
J10006	BVIDEO	TTL	OUTPUT
J10007	SCOPE TRIG	TTL	OUTPUT
J10008	EXT SYNC	TTL	OUTPUT
J10009	PREPULSE	TTL	OUTPUT
J10010	AUXILIARY	VARIOUS	INPUT/OUTPUT
J10013	RF VERNIER	0 TO 7 Vdc	OUTPUT
J10014	MEASURE GATE	TTL	OUTPUT
J10015	DPSK	BIPOLAR	OUTPUT
PROCESSOR PC BOARD ASSEMBLY			
J10011	IFR BUS	TTL	INPUT/OUTPUT
J10012	TEST	RS-232C	INPUT/OUTPUT

2. S-1403C AUXILIARY Connector (J10010) (To ATC-1400A, J6) Pin-Out Table

PIN NO.	SIGNAL NAME	SIGNAL TYPE	INPUT/OUTPUT	POLARITY
1	GROUND			
2	SPARE			
3	SPARE			
4	SPARE			
5	EXTPULSE	TTL	OUTPUT	ACTIVE LOW
6	EXT SLS	TTL	OUTPUT	ACTIVE LOW
7	SPARE			
8	PULSE	TTL	INPUT	POSITIVE
9	20 MHz	TTL	INPUT	RISING EDGE
10	SPARE			
11	50% VIDEO	TTL	INPUT	POSITIVE
12	SPARE			
13	SPARE			
14	SELF INTERROGATE	TRISTATE	INPUT/OUTPUT	RISING EDGE
15	GROUND			
16	GROUND			
17	GROUND			
18	GROUND			
19	GROUND			
20	GROUND			
21	GROUND			
22	GROUND			
23	SPARE			
24	GROUND			
25	SPARE			

3. S-1403C IFR BUS Connector (J10011) (To ATC-1400A, J5) Pin-Out Table

PIN NO.	SIGNAL NAME	SIGNAL TYPE	INPUT/OUTPUT	POLARITY
1	GROUND			
2	A0	TTL	INPUT	POSITIVE
3	A1	TTL	INPUT	POSITIVE
4	GROUND			
5	A2	TTL	INPUT	POSITIVE
6	D7	TTL	INPUT/OUTPUT	POSITIVE
7	D6	TTL	INPUT/OUTPUT	POSITIVE
8	A3	TTL	INPUT	POSITIVE
9	GROUND			
10	GROUND			
11	NOT USED			
12	D5	TTL	INPUT/OUTPUT	POSITIVE
13	GROUND			
14	NOT USED			
15	D4	TTL	INPUT/OUTPUT	POSITIVE
16	GROUND			
17	WRITE	TTL	INPUT	POS STROBE
18	D3	TTL	INPUT/OUTPUT	POSITIVE
19	GROUND			
20	READ	TTL	INPUT	POS STROBE
21	D2	TTL	INPUT/OUTPUT	POSITIVE
22	INTA	OC	OUTPUT	ACTIVE LOW
23	INTR	OC	INPUT	ACTIVE
24	D1	TTL	INPUT/OUTPUT	POSITIVE
25	D0	TTL	INPUT/OUTPUT	POSITIVE

4. SCOPE TRIG Connector (J10007) Output Pulse Description

A. ATC Test Function

T_O Setting:

Width:
3.0 µs (Mode 1)
5.0 µs (Mode 2)
6.5 µs (Mode T)
8.0 µs (Mode 3/A)
17.0 µs (Mode B)
21.0 µs (Mode C)
25.0 µs (Mode D)

Position: 1.0 µs prior to leading edge of P_1

T_D Setting:

Width: 20.3 µs

Position: 2.0 µs following leading edge of P_3

B. SEQ Test Function

T_O Setting:

Width: 4.75 µs

Position: 1.0 µs prior to leading edge of P_1

T_D Setting:

Width: 8.0 µs

Position: 127 µs following SPR

C. ACS/ACL Test Functions

T_O Setting:

Width:
5.0 µs (Mode 1)
7.0 µs (Mode 2)
8.5 µs (Mode T)
10.0 µs (Mode 3/A)
19.0 µs (Mode B)
23.0 µs (Mode C)
27.0 µs (Mode D)

Position: 1.0 µs prior to leading edge of P_1

T_D Setting

Width: 8.0 µs

Position: 1.0 µs prior to reply, P_1 or F_1 leading edge

D. INTLCE Test Function

T_O Setting:

Width:	6.0 µs (Mode 1) 8.0 µs (Mode 2) 9.5 µs (Mode T) 11.0 µs (Mode 3/A) 20.0 µs (Mode B) 24.0 µs (Mode C) 28.0 µs (Mode D)
Position:	1.0 µs prior to leading edge of ATCRBS P_1

T_D Setting:

Width:	132.75 µs
Position:	1.0 µs prior to rising edge of P_1 in the Mode S interrogation

E. DI Test Function

T_O Setting:

Width:	6.00 µs (Mode 1) 8.00 µs (Mode 2) 9.05 µs (Mode T) 11.00 µs (Mode 3/A) 20.00 µs (Mode B) 24.00 µs (Mode C) 28.00 µs (Mode D) 132.75 µs (Mode S)
Position:	1.0 µs prior to leading edge of P_1 in the first interrogation

T_D Setting:

Width:	6.00 µs (Mode 1) 8.00 µs (Mode 2) 9.50 µs (Mode T) 11.00 µs (Mode 3/A) 20.00 µs (Mode B) 24.00 µs (Mode C) 28.00 µs (Mode D) 132.75 µs (Mode S)
Position:	1.0 µs prior to leading edge of P_1 in the second interrogation

F. BURST Test Function

Refer to applicable test function.

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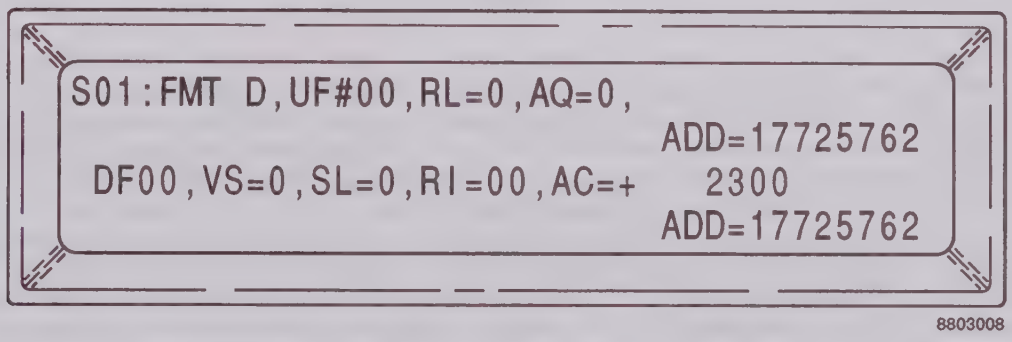
APPENDIX B - DEFINED SEQUENCE MENU FORMATS

The Mode S Test System contains seven defined sequence menu formats. The flexibility of the Mode S Test System allows any defined sequence menu format to be used in programming any of the 16 sequence menus. On power-up, the first eight sequence menus are programmed with defined sequence menu formats (default) according to this Appendix. Refer to Appendix E for detailed explanation of the various uplink and downlink format fields.

NOTE: Most uplink and downlink fields are displayed in octal form. Appendix E uses decimal and binary forms. Refer to 1-2-5D for examples and conversion table.

1. Uplink/Downlink Format 00 (Short Air-to-Air Surveillance) (Default Sequence Menu S01)

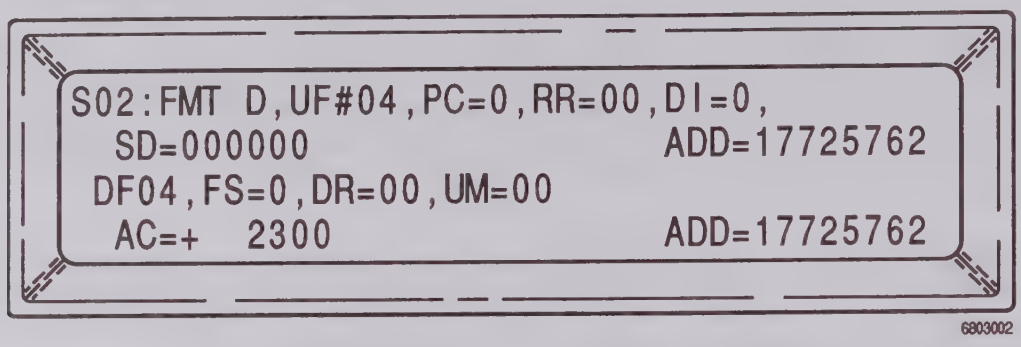


UF00/DF00 Defined Sequence Menu (Default S01)
Figure 1

UF00 interrogations contain three variable fields. ***RL=*** (Reply Length) field selects reply format depending on UUT transponder type. If the UUT is associated with Airborne Collision Avoidance System (ACAS) equipment, ***RL=0*** selects DF00 replies and ***RL=1*** selects DF16 replies. Otherwise, ***RL=0*** selects DF00 replies and ***RL=1*** selects no replies. ***AQ=*** (Acquisition) field requests specific information in the reply (***RI=*** field). ***AQ=0*** requests UUT TCAS capability information, if applicable. ***AQ=1*** requests UUT airspeed information. The interrogations are sent to the UUT address specified in the ***ADD=*** field. The octal address is sent as the 24-bit AP field (address overlaid with parity data bits).

Replies from the UUT are displayed as either DF00 or DF16, depending on ***RL=*** field setting in the interrogation and normal UUT operation. DF00 contains five displayed fields. ***VS=*** (Vertical Status) field provides UUT flight status. ***VS=0*** indicates UUT aircraft is airborne and ***VS=1*** indicates UUT aircraft is on the ground. ***SL=*** (Sensitivity Level) field reports current UUT TCAS sensitivity level (***SL=0*** indicates no sensitivity level reported). ***RI=*** field provides the information requested in the interrogation (***AQ=*** field). ***RI=00*** to ***07*** (0 to 7, decimal) provides TCAS capability information. ***RI=10*** to ***17*** (8 to 15, decimal) provides airspeed information. ***AC=*** field reports UUT altitude in feet, calculated from the AC field value received in the reply. The ***ADD=*** field provides the UUT address taken from the AP field value received in the reply. The ***ADD=*** field from the reply matches the interrogation ***ADD=*** field during correct operation. ****** No Reply ***** is displayed when no replies are received.

2. Uplink/Downlink Format 04 (Surveillance/Altitude) (Default Sequence Menu S02)

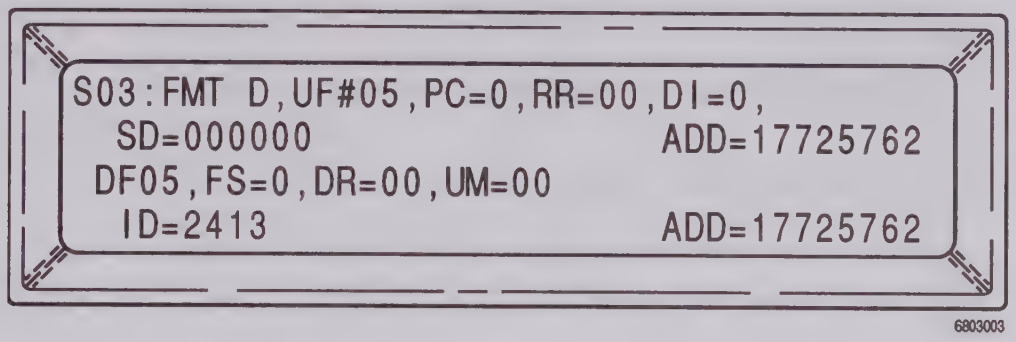


UF04/DF04 Defined Sequence Menu (Default S02)
Figure 2

UF04 interrogations contain five variable fields. ***PC=*** (Protocol) field provides operating instructions to the UUT. ***RR=*** (Reply Request) field instructs the UUT what reply and information to send. ***RR=00*** to ***17*** (0 to 15, decimal) requests a DF04 reply. ***RR=20*** (16, decimal) requests a DF20 reply (Comm-B) containing the message the UUT requested to send in earlier reply (***DR=01*** or ***03***). ***RR=21*** (17, decimal) requests a DF20 reply containing UUT data link capability. ***RR=22*** (18, decimal) requests a DF20 reply containing UUT aircraft identification (tail number). ***RR=23*** (19, decimal) requests a DF20 reply containing TCAS resolution advisory information. ***RR=24*** to ***37*** (20 to 31, decimal) requests a DF20 reply (not assigned to specific information). ***DI=*** field designates the content of the ***SD=*** field. ***SD=*** field contains Interrogator Identifier, Mode S Only All-Call lockout instructions, multisite information, specific reply requests and/or message information. ***ADD=*** field operates the same as in UF00.

Replies from the UUT are displayed as either DF04 or DF20, depending on ***RR=*** field setting in the interrogation and normal UUT operation. DF04 contains five displayed fields. ***FS=*** (Flight Status) field reports UUT flight status and alert conditions. ***DR=*** (Downlink Request) field indicates UUT request to send message. ***UM=*** (Utility Message) field contains UUT status (message reservations). ***AC=*** and ***ADD=*** fields operate the same as in DF00. ****** No Reply ***** is displayed when no replies are received.

3. Uplink/Downlink Format 05 (Surveillance/Identity) (Default Sequence Menu S03)

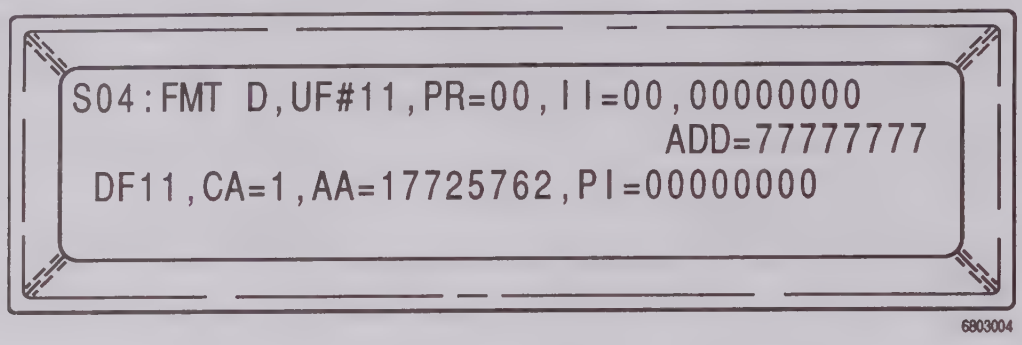


UF05/DF05 Defined Sequence Menu (Default S03)
Figure 3

UF05 interrogations contain the same five variable fields as in UF04. ***PC=***, ***DI=***, ***SD=*** and ***ADD=*** fields operate the same as in UF04. ***RR=*** field operates the same as in UF04, but requests different replies. ***RR=00*** to ***17*** (0 to 15, decimal) requests a DF05 reply. ***RR=20*** (16, decimal) requests a DF21 reply (Comm-B) containing the message the UUT requested to send in earlier reply (***DR=01*** or ***03***). ***RR=21*** (17, decimal) requests a DF21 reply containing UUT data link capability. ***RR=22*** (18, decimal) requests a DF21 reply containing UUT aircraft identification (tail number). ***RR=23*** (19, decimal) requests a DF21 reply containing TCAS resolution advisory information. ***RR=24*** to ***37*** (20 to 31, decimal) requests a DF21 reply (not assigned to specific information).

Replies from the UUT are displayed as either DF05 or DF21, depending on ***RR=*** field setting in the interrogation and normal UUT operation. DF05 contains five displayed fields. ***FS=***, ***DR=***, ***UM=*** and ***ADD=*** fields operate the way as in DF04. ***ID=*** (Identification) field contains the 4096 identification code set on the UUT. ****** No Reply ****** is displayed when no replies are received.

4. Uplink/Downlink Format 11 (Mode S Only All-Call) (Default Sequence Menu S04)

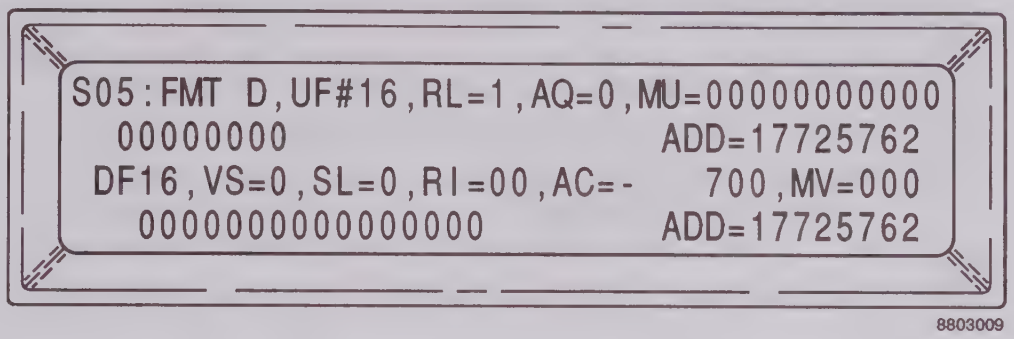


UF11/DF11 Defined Sequence Menu (Default S04)
Figure 4

UF11 is the Mode S Only All-Call. Interrogations contain three variable fields. ***PR=*** (Probability of Reply) field specifies UUT reply probability and overrides lockout instructions if desired. This reply probability is used to separate replies in a saturated ATC environment. ***PR=00*** or ***10*** (0 or 8, decimal) requests the UUT to reply normally. ***PR=05*** to ***07*** or ***15*** to ***17*** (5 to 7 or 13 to 15, decimal) requests the UUT to not reply. Other ***PR=*** field codes request the UUT to reply at a specific ratio to interrogations (refer to Appendix E). ***II=*** (Interrogator Identifier) field identifies the interrogator. The ***II=*** field is the same information as the first two digits of the ***SD=*** field in UF04, UF05, UF20, and UF21 interrogations. The seven digits after the ***II=*** field represent the 19 undefined bits in UF11 and are set to zero.

DF11 replies contain three displayed fields. ***CA=*** (Capability) field reports UUT transponder capabilities. ***CA=0*** indicates the UUT only receives and transmits short formats. ***CA=1*** indicates the UUT receives short or Comm-A message formats and transmits short or Comm-B message formats. ***CA=2*** indicates the UUT receives short, Comm-A message or Extended Length Message (ELM) formats and transmits short or Comm-B message formats. ***CA=3*** indicates the UUT receives short, Comm-A message or Extended Length Message (ELM) formats and transmits short, Comm-B message or ELM formats. ***AA=*** (Aircraft Address) field contains the UUT address. ***PI=*** field contains the parity code overlaid on the Interrogator Identifier code. ****** No Reply ***** is displayed when no replies are received.

5. Uplink/Downlink Format 16 (Long Air-to-Air Surveillance) (Default Sequence Menu S05)

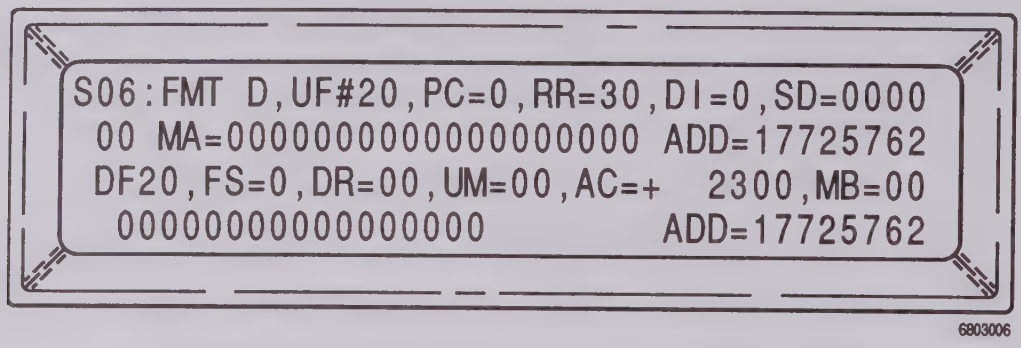


UF16/DF16 Defined Sequence Menu (Default S05)
Figure 5

UF16 interrogations contain four variable fields. ***RL=***, ***AQ=*** and ***ADD=*** fields operate the same as in UF00. ***MU=*** field contains information used in air-to-air exchanges (TCAS messages).

Replies from the UUT are displayed as either DF00 or DF16, depending on ***RL=*** field setting in the interrogation and normal UUT operation. DF16 contains six defined fields. ***VS=***, ***SL=***, ***RI=***, ***AC=*** and ***ADD=*** fields operate the same as in DF00. ***MV=*** field contains information used in air-to-air exchanges (coordination reply messages) and does not follow Comm-B format. ****** No Reply ****** is displayed when no replies are received.

6. Uplink/Downlink Format 20 (Comm-A/Comm-B/Altitude) (Default Sequence Menu S06)

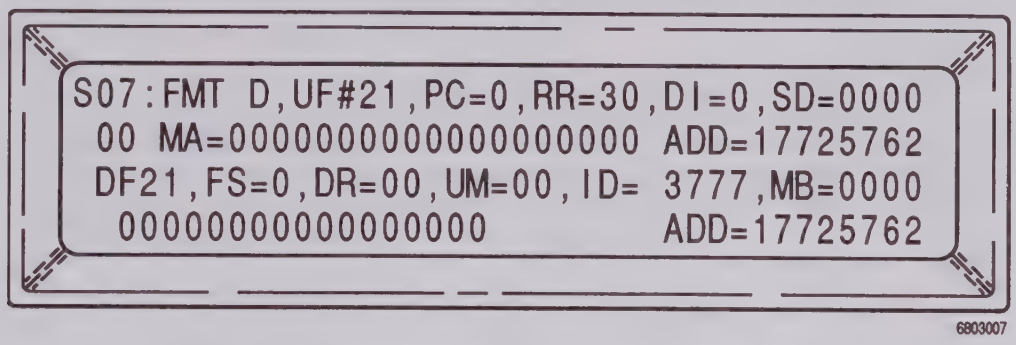


UF20/DF20 Defined Sequence Menu (Default S06)
Figure 6

UF20 interrogations contain six variable fields. ***PC=***, ***RR=***, ***DI=***, ***SD=*** and ***ADD=*** fields operate the same as in UF04. ***MA=*** field contains messages to the UUT and uses Comm-A format.

Replies from the UUT are displayed as either DF04 or DF20, depending on ***RR=*** field setting in the interrogation and normal UUT operation. DF20 contains six displayed fields. ***FS=***, ***DR=***, ***UM=***, ***AC=*** and ***ADD=*** fields operate the same as in DF04. ***MB=*** field contains messages to the interrogator and uses Comm-B format.
****** No Reply ****** is displayed when no replies are received.

7. Uplink/Downlink Format 21 (Comm-A/Comm-B/Identity) (Default Sequence Menu S07)

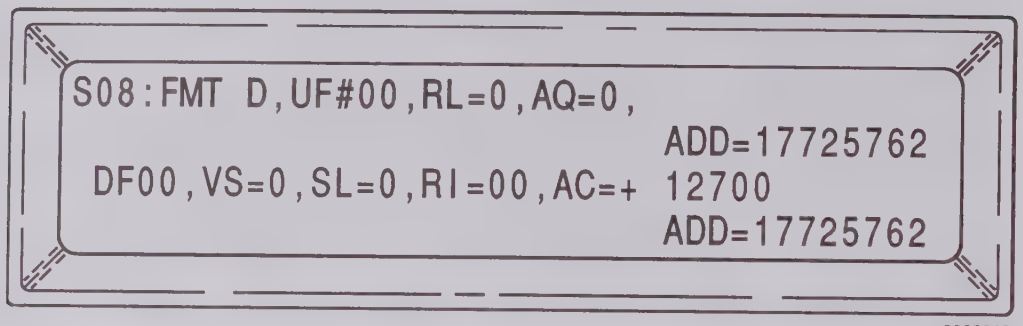


UF21/DF21 Defined Sequence Menu (Default S07)
Figure 7

UF21 interrogations contain six variable fields. ***PC=***, ***RR=***, ***DI=***, ***SD=*** and ***ADD=*** fields operate the same as in UF05. ***MA=*** field operates the same as in UF20.

Replies from the UUT are displayed as either DF05 or DF21, depending on ***RR=*** field setting in the interrogation and normal UUT operation. DF21 contains six displayed fields. ***FS=***, ***DR=***, ***UM=***, ***ID=*** and ***ADD=*** fields operate the same as in DF05. ***MB=*** field operates the same as in DF20. ****** No Reply ****** is displayed when no replies are received.

8. Default Sequence Menu S08



Default Sequence Menu S08
Figure 8

Default Sequence Menu S08 displays the UF00 defined sequence menu.

APPENDIX C - TEST EQUIPMENT REQUIREMENTS

1. General

This Appendix contains a list of test equipment suitable for performing all of the testing procedures contained in this manual. Other equipment meeting the specifications listed in this Appendix may be substituted in place of the recommended models. The equipment listed in this Appendix may exceed the minimum required specifications for some of the procedures contained in this manual.

2. Recommended Test Equipment

TYPE	MODEL	SPECIFICATIONS
Heterodyne Monitor	ANZAC MD-141 or Equivalent	
Dual Pulse Generator	WAVETEK 145 or Equivalent	Functions: Pulse Pulse Delay: 50 ns to 10 ms Pulse Width: 25 ns to 1 ms Output Level: 15 V_{P-P} into 50 Ω
Oscilloscope	TEK 2465 or Equivalent	Dual Trace Bandwidth: dc to 100 MHz Vertical Accuracy ±10% Time Accuracy: ±0.7% of Time Interval ±0.6% of Full Scale Δ Time Accuracy: ±0.7% of Time Interval ±0.3% of Full Scale
Power Meter	BOONTON 4200 (with Power Sensor) or Equivalent	Range: -25 to -15 dBm Accuracy: ±0.05 dB

TYPE	MODEL	SPECIFICATIONS
RF Signal Generator	HP8640B or Equivalent	Frequency Range: 1 to 1030 MHz Resolution: 0.1 to 100 Hz Accuracy: 2×10^{-6} RF Output: 13 to -130 dBm
Spectrum Analyzer	HP8569B or Equivalent	Frequency Range: 10 kHz to 2.6 GHz Resolution Bandwidth: 300 Hz to 3.0 MHz Display Accuracy Log: <±0.1 dB/dB <±1.5 dB/70 dB Display Accuracy Linear: <±3% of reference level over 8 division deflection

APPENDIX D - ABBREVIATIONS

A

A	Amperes
AA	Address Announced
AC	Altitude Code
ac	Alternating Current
ACAS	Airborne Collision Avoidance System
ACL	All-Call Long
ACS	All-Call Short
ADD	Address
ADS	A-Definition Subfield
AM	Amplitude Modulation
ANT	Antenna
Ant	Antenna
AP	Address Parity
APER	Ant A Percent Reply for ATCRBS
AQ	Acquisition Special
ASCII	American Standard Code for Information Interchange
ATC	ATCRBS
ATCRBS	Air Traffic Control Radar Beacon System
ATE	Automatic Test Equipment

B

BDS	B-Definition Subfield
BN	BURST Number
BPER	Ant B Percent Reply
BPulse	Diversity Pulse
BRF	RF through Ant B
Brf	RF through Ant B
BRFLV	RF level through Ant B
Brflvl	RF level through Ant B
BVideo	Diversity Video

C

C	Centigrade
CA	Capability
CAL	Calibrated Position
ccw	Counterclockwise
CFS	Continuation Subfield
CHAN	Channel
CMENU	Control Menu
Cont	Continued
CW	Continuous Wave
cw	Clockwise

D

DABS	Discrete Address Beacon System
dB	Decibel
DBL	Double
dBm	Decibels compared to 1 milliwatt.
DEV	Deviation
DF	Downlink Format
DFSQnn	Downlink Format Sequence Number
DI	Designator Identification
DI	Double Interrogation
DISC	Discrete
DME	Distance Measuring Equipment
DMM	Digital Multimeter
DO	Document
DPSK	Differential Phase Shift Keying
DR	Downlink Request
Dv	Deviation

E

ECL	Extended Command Language
ECS	Extended Capability Subfield
ELM	Extended Length Message
ENT	Enter
ERRM	Error Message
ESC	Escape
EXMOD	External Modulation
EXSYN	External Synchronization
EXT	External
Ext	External

F

FMT	Format
FPCPU	Front Panel Central Processing Unit
FPM	Feet Per Minute
FREQ	Frequency
FS	Flight Status
FUNC	Function
Fun	Function
FUN NO	Function Number
F/W	Firmware

G

GEN	Generator
GHz	Gigahertz (10^9)
GND	Ground
GPIB	General Purpose Interface Bus

H

Hz	Hertz
h	Hexidecimal

I

ID	Identification (4906 Code)
IEEE	Institute of Electrical and Electronics Engineers
IDS	Identifier Designators Subfield
IFR	IFR Systems, Inc
II	Interrogator Identification
IIS	Interrogator Identification Subfield
IN	Input
INTRF	Interference
INTERR	Interrogation
INTERRF	Interference
INTLCE	Interlace

K

KE	Control, ELM
kHz	Kilohertz (10^3)
kts	Knots (Velocity)

L

LCD	Liquid Crystal Display
LED	Light Emitting Diode
LOS	Lockout Subfield
LVL	Level

M

MA	Message, COMM-A
MAN	Manual
MAX	Maximum
MB	Message, COMM-B
MBS	Multisite COMM-B Subfield
MC	Message, COMM-C
MCPU	Main Central Processing Unit
MD	Message, COMM-D
MES	Multi-site ELM Sub-field
MHz	Megahertz (10^6)
MIN	Minimum
MLD	Multi-Level Diversity
ms	Millisecond (10^{-3})
MTL	Minimum Threshold Level
MU	Message, COMM-U
MV	Message, COMM-V

N

NA	Not Applicable
NC	Number of C-Segment
ND	Number of D Segment
NO	Number
No	Number
NORM	Normal
ns	Nanosecond (10^{-9})

O

OC	Open Collector
OUT	Output

P

PC	Protocol
PI	Parity/Interrogator Identity
PLCS	Places
PN	Part Number
POS	Positive
PPG	Pulse Power Gate
PPM	Pulse Position Modulation
PPMG	Pulse Power Measurement Gate
PPULSE	Prepulse
PPuls	Prepulse
PR	Probability of Reply
PRF	Pulse Repetition Frequency
PRPLY	Percent Reply
PWR	Power

R

RAM	Random Access Memory
RC	Reply Control
RCVDATA	Receive Data
RECALLn	Recall (number)
RF	Radio Frequency
RFLV	RF Level
RFLvl	RF Level
RI	Reply Information, Air-to-Air
RL	Reply Length
RMS	Root Mean Square
ROM	Read Only Memory
RPDLY	Reply Delay
RpDly	Reply Delay
RR	Reply Request
RRS	Reply Request Subfield
RSS	Reservation Status Subfield
RTCA	Radio Technical Commission for Aeronautics

S

SAVEn	Save (number)
SCOPE	Oscilloscope
SD	Special Designator
sec	seconds
SEQ	Sequence
Seq	Sequence
SEQn	Sequence Number
SLS	Side-Lobe Suppression
SMENU	Sequence Menu
SPI	Special Identifier Pulse
spi	Special Identifier Pulse
SPER	Ant A Percent Reply for Mode S
SPR	Synchronous Phase Reversal
SQADD	Squitter Address
SQnn	Sequence Menu (number)
SQTR	Squitter
Sqtr	Squitter
SRQ	Service Request
SRS	Segment Request Subfield
SSR	Secondary Surveillance Radar
STATMTL	MTL Status
SYNC	Synchronous
sync	Synchronous

T

T	Transformer
TAC	TACAN
TCAS	Traffic Alert and Collision Avoidance System
TCXO	Temperature Compensated Crystal Oscillator
T_D	Reply Sync
TMS	Tactical Message Subfield
T_O	Interrogation sync
TRIG	Trigger
TTL	Transistor-Transistor Logic
TYP	Typical

U

UF	Uplink Field
UM	Utility Message
UUT	Unit Under Test

V

V	Volts
VAC	Volts Alternating Current
VAR	Variation
VCO	Voltage Controlled Oscillator
Vdc	Volts Direct Current
VER	Version (firmware)
V_{P-P}	Volts Peak-to-Peak
VRAM	Video Random Access Memory
Vrms	Volts Root Mean Square
VS	Vertical Status

W

W	Watts
Wd	Width

X

XMIT	Transmit
XMTR	Transmitter
XPDR	Transponder

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APPENDIX E - SIGNAL FORMATS

1. Operating Goals

Mode S is a combined secondary surveillance radar and a potential ground-air-ground data link system capable of providing aircraft surveillance and communications necessary to support automated ATC in dense traffic environments. Mode S is capable of common-channel interoperation with the ATC beacon system and may be implemented over an extended ATCRBS-to-Mode S transition period. In supporting ATC automation, Mode S is capable of providing the reliable communications necessary for data link services.

2. Mode S Message Content

A. Address/Parity (Field AP)

All discrete Mode S interrogations (56-bit or 112-bit) and replies (except the All-Call reply) contain the 24-bit discrete address of the Mode S transponder upon which 24 error-detecting parity check bits are overlaid. In the All-Call reply, the 24 parity check bits are overlaid on the address of the Mode S interrogator and the discrete address of the transponder is included in the text of the reply.

B. Surveillance

The primary function of Mode S is surveillance. For the Mode S transponder, this function is accomplished with the use of "short" (56-bit) transmissions in both directions. In these transmissions, the aircraft reports altitude (DF04) or ATCRBS 4096 code as well as flight status (airborne, on the ground, alert, Special Position Identification [SPI], etc.).

C. Data Link Communications

The discrete addressing and digital encoding allow Mode S transmissions to be used as digital data links. The interrogation and reply formats of the Mode S system contain sufficient coding space to transmit data. Most Mode S data link transmissions are handled as one 56-bit message included as part of "long" 112-bit interrogations or replies. The transmissions include the message in addition to surveillance data, and is generally used in place of a surveillance interrogation and/or reply.

An efficient transmission of longer messages is accomplished by the extended length message (ELM) capability (UF24 and DF24). Using this capability, a sequence of up to sixteen 80-bit message segments (each with a 112-bit transmission) is transmitted, either ground-to-air or air-to-ground and is acknowledged with a single reply/interrogation. ELMs do not contain surveillance data and thus cannot substitute for a surveillance interrogation-reply cycle.

3. Signal Formats

Signal formats for both uplink and downlink messages are outlined in Chapter 2, RTCA DO-181 and Chapter 2, Volume I of RTCA DO-185. Tables 1, 2, 3 and 4 contain explanations of signals and their meanings.

NOTE: TCAS operates in Mode S and many signals pertain only to TCAS.

FORMAT NO.	UF	
0	(0 0000)	--3--(RL:1)—4—(AQ:1)——18——(AP:24) .....Short Air-Air Surveillance
1	(0 0001)	————————27 or 83————————(AP:24)
2	(0 0010)	————————27 or 83————————(AP:24)
3	(0 0011)	————————27 or 83————————(AP:24)
4	(0 0100)	(PC:3) (RR:5) (DI:3) (SD:16) (AP:24) ... Surveillance, Altitude Request
5	(0 0101)	(PC:3) (RR:5) (DI:3) (SD:16) (AP-24) ....Surveillance, Identity Request
6	(0 0110)	————————27 or 83————————(AP:24)
7	(0 0111)	————————27 or 83————————(AP:24)
8	(0 1000)	————————27 or 83————————(AP:24)
9	(0 1001)	————————27 or 83————————(AP:24)
10	(0 1010)	————————27 or 83————————(AP:24)
11	(0 1011)	(PR:4) (II:4)————-19————-(AP:24) ..... Mode S Only All-Call
12	(0 1100)	————————27 or 83————————(AP:24)
13	(0 1101)	————————27 or 83————————(AP:24)
14	(0 1110)	————————27 or 83————————(AP:24)
15	(0 1111)	————————27 or 83————————(AP:24)
16	(1 0000)	-3-(RL:1)-4-(AQ:1)—18—(MU:56) (AP:24) ..... Long Air-Air Surveillance
17	(1 0001)	————————27 or 83————————(AP:24)
18	(1 0010)	————————27 or 83————————(AP:24)
19	(1 0011)	————————27 or 83————————(AP:24)
20	(1 0100)	(PC:3) (RR:5) (DI:3) (SD:16) (MA:56) (AP:24) ..Comm-A, Altitude Request
21	(1 0101)	(PC:3) (RR:5) (DI:3) (SD:16) (MA:56) (AP:24) ..Comm-A, Identity Request
22	(1 0110)	————————27 or 83————————(AP:24)
23	(1 0111)	————————27 or 83————————(AP:24)
24	(1 1xxx)	(RC:2) (NC:4) (MC:80) (AP:24) ..... Comm-C (ELM)

NOTE: (XX:M) denotes a field designated "XX" which is assigned M bits.

NOTE: —N— denotes free coding space with N available bits. These are coded as ZEROs for transmission.

NOTE: For Uplink Formats (UF) 0 through 23, the format number corresponds to the binary code in the first 5 bits of the interrogation. Format number 24 is arbitrarily defined as the format beginning with "11" in the first two bit positions while the following three bits (xxx) vary with the interrogation content.

NOTE: All formats are shown for completeness, although a number of them are unused.

Overview of Mode S Interrogation Formats
Table 1

FORMAT NO. DF		
0	(0 0000) (VS:1)-2-(SL:3)-2-(RI:4)-2-(AC:13) (AP:24)	Short Air-Air Surveillance
1	(0 0001) —27 or 83—(P:24)	
2	(0 0010) —27 or 83—(P:24)	
3	(0 0011) —27 or 83—(P:24)	
4	(0 0100) (FS:3) (DR:5) (UM:6) (AC:13) (AP:24)	Surveillance, Altitude Reply
5	(0 0101) (FS:3) (DR:5) (UM:6) (ID:13) (AP-24)	Surveillance, Identity Reply
6	(0 0110) —27 or 83—(P:24)	
7	(0 0111) —27 or 83—(P:24)	
8	(0 1000) —27 or 83—(P:24)	
9	(0 1001) —27 or 83—(P:24)	
10	(0 1010) —27 or 83—(P:24)	
11	(0 1011) (CA:3) (AA:24) (PI:24)	All-Call Reply/Squitter
12	(0 1100) —27 or 83—(P:24)	
13	(0 1101) —27 or 83—(P:24)	
14	(0 1110) —27 or 83—(P:24)	
15	(0 1111) —27 or 83—(P:24)	
16	(1 0000)(VS:1)-2-(SL:3)-2-(RI:4)-2-(AC:13)(MV:56)(AP:24)	Long Air-Air Surveillance
17	(1 0001) —27 or 83—(P:24)	
18	(1 0010) —27 or 83—(P:24)	
19	(1 0011) —27 or 83—(P:24)	
20	(1 0100) (FS:3) (DR:5) (UM:6) (AC:13) (MB:56) (AP:24)	Comm-B, Altitude Reply
21	(1 0101) (FS:3) (DR:5) (UM:6) (ID:13) (MB:56) (AP:24)	Comm-B, Identity Reply
22	(1 0110) —27 or 83—(P:24)	
23	(1 0111) —27 or 83—(P:24)	
24	(1 1xxx) (KE:1) (ND:4) (MD:80) (AP:24)	Comm-D (ELM)

NOTE: (XX:M) denotes a field designated "XX" which is assigned M bits.

NOTE: (P:24) denotes a 24-bit field reserved for parity information.

NOTE: —N— denotes free coding space with N available bits. These are coded as ZEROs for transmission.

NOTE: For Downlink Formats (DF) 0 through 23, the format number corresponds to the binary code in the first 5 bits of the reply. Format number 24 is arbitrarily defined as the format beginning with "11" in the first two bit positions while the following three bits (xxx) vary with reply content.

NOTE: All formats are shown for completeness, although a number of them are unused.

Overview Of Mode S Reply Formats
Table 2

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
AA		24	9-32		X	The aircraft address in the clear, used in DF=11, the All-Call reply.
AC		13	20-32		X	The altitude code used in formats DF=0, 4, 16 and 20. All bits are "0" if altitude information is not available. Contains metric altitude if M-bit (26) is "1".
AP		24 24	33-56 89-112	X	X	Parity overlaid on the address appears at the end of all transmissions, both uplink and downlink, with the exception of format DF=11.
AQ		1	14	X		Designates formats UF=0, 16 as acquisition transmissions. Bit 14 (RI, DF=0, 16) repeats AQ as received by transponder.
CA		3	6-8		X	Reports transponder capability and is used in DF=11, squitter or all-call reply. The codes are: 0 = Level 1, no communications capability (surveillance only), Transponder accepts UF=0, 4, 5, 11; Transponder transmits DF=0, 4, 5, 11. 1 = Level 2, Comm-A and Comm-B capability, Transponder accepts UF=0, 4, 5, 11, 20, 21; Transponder transmits DF=0, 4, 5, 11, 20, 21. 2 = Level 3, Comm-A, Comm-B and uplink ELM capability, Transponder accepts UF=0, 4, 5, 11, 20, 21, 24; Transponder transmits DF=0, 4, 5, 11, 20, 21. 3 = Level 4, Comm-A, Comm-B, uplink and downlink ELM capability, Transponder accepts UF=0, 4, 5, 11, 20, 21, 24; Transponder transmits DF=0, 4, 5, 11, 20, 21, 24. 4 = Level 2,3 or 4; ability to set code 7 and is on the ground. 5 = Level 2,3 or 4; ability to set code 7 and is airborne. 6 = Level 2,3 or 4; ability to set code 7. 7 = DR≠0 or FS=3,4 or 5. **NOTE**: Codes 4-7 are for squitters only.
DF		5	1-5		X	The first field in all downlink formats is the transmission descriptor.

Overview of Format Definitions
Table 3

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
DI		3	14-16	X		Identifies coding contained in the SD field in formats UF=4, 5, 20, 21. The codes are: 0 = SD has Interrogator Identifier (IIS). 1 = SD contains (IIS, MBS, MES, LOS, RSS, TMS). 2-6 = Not assigned. 7 = SD contains (IIS, RRS, LOS, TMS).
DR		5	9-13		X	Requests extraction of downlink messages from the transponder by the interrogator and appears in formats DF=4, 5, 20, 21. The codes are: 0 = No downlink request. 1 = Request to send Comm-B message (B bit set) 2 = TCAS information available. 3 = TCAS information available and request to send Comm-B message. 4 = Comm-B Broadcast #1 available. 5 = Comm-B Broadcast #2 available. 6 = TCAS information and Comm-B Broadcast #1 available. 7 = TCAS information and Comm-B Broadcast #2 available. 8-15 = Not assigned. 16-31 = Request to send n-segments, signified by 15 + n. Codes 1-15 take precedence over codes 16-31.
FS		3	6-8		X	Reports the flight status of the aircraft and is used in formats DF=4, 5, 20, 21. The codes are: Code / Alert / SPI / Airborne / On the Ground 0 / no / no / yes / no 1 / no / no / no / yes 2 / yes / no / yes / no 3 / yes / no / no / yes 4 / yes / yes / either 5 / no / yes / either 6, 7 are not assigned.
ID		13	2-32		X	The 4096 identification code, numbers as set by the pilot, in DF=5, 21.

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
II		4	10-13	X		Identifies the interrogator and appears in UF=11, the Mode S-Only All-Call. **NOTE:** The same information may also appear in the IIS subfields.
KE		1	4		X	Defines the content of the ND and MD fields in Comm-D replies, DF=24.
MA		56	33-88	X		Messages directed to the aircraft, part of Comm-A interrogations, UF=20, 21.
	ADS	8	33-40	X		Defines the content of the MA message field in Comm-A requests and is expressed in two groups of 4 bits each, ADS1 (33-36) and ADS2 (37-40).
	ADS1	4	33-36	X		Part of the A-Defintition Subfield and is set to "0" for TCAS Sensitivity Level Commands.
	ADS2	4	37-50	X		Part of the A-Defintition Subfield and is set to "5" for TCAS Sensitivity Level Commands.
	SLC	4	41-44	X		Sensitivity Level Command for the TCAS aircraft. The codes are: 0 = No command 1 = Not Assigned. 2 = Select TA_ONLY mode of operation. 3 = Set TCAS Sensitivity Level to 3. 4 = Set TCAS Sensitivity Level to 4. 5 = Set TCAS Sensitivity Level to 5. 6 = Set TCAS Sensitivity Level to 6. 7 = Set TCAS Sensitivity Level to 7. 8-14 = Not Assigned 15=Cancel previous Sensitivity Level command from this site.
MB		56	33-88		X	Messages to be transmitted to the interrogator, part of the Comm-B replies, DF=20, 21. The field contains Data Link Capability Reports or Aircraft Identification Reports or TCAS Resolution Advisory Reports.

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
MB	ACS	20	45-64		X	Comm-A capability subfield reports data link service(s) supported by the installation. If all bits are "0", no Comm-A data link services are supported.
	AIS	48	41-88		X	Aircraft Identification Number, reported when a surveillance or Comm-A interrogation (UF=4, 5, 20, 21) contains RR=18 and DI=anything but 7. AIS contains up to eight 6-bit characters as defined in Table 4.
	ARA	14	41-54		X	TCAS Resolution Advisory Report indicating current Active Resolution Advisories (if any) generated by own TCAS unit against one or more threat aircraft. Each bit indicates a specific resolution advisory with "1" being active and "0" being inactive. Bit indications are: 41-Climb. 42-Don't descend. 43-Don't descend faster than 500 FPM. 44-Don't descend faster than 1000 FPM. 45-Don't descend faster than 2000 FPM. 46-Descend. 47-Don't climb. 48-Don't climb faster than 500 FPM. 49-Don't climb faster than 1000 FPM. 50-Don't climb faster than 2000 FPM. 51-Turn left. 52-Turn right. 53-Don't turn left. 54-Don't turn right.
	BCS	16	65-80		X	Comm-B capability subfield reports installed data sources that can be accessed by the ground for transmission via a ground-initiated Comm-B. If all bits are "0", no data is accessible by a ground-initiated Comm-B.
	BDS	8	33-40		X	Defines the content of the MB message field in reply to ground-initiated Comm-B and is expressed in two groups of 4 bits each, BDS1 (33-36) and BDS2 (37-40).

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
MB	BDS1	4	33-36		X	Corresponds with RR in UF=4, 5, 20 and 21. The codes are: 0 = MB contains Air-initiated Comm-B. 1 = MB contains Data Link Capability Report. 2 = MB contains Aircraft Identification. 3 = MB contains TCAS Resolution Advisory. 4-15 = Not assigned.
	BDS2	4	37-40		X	Basic report uses BDS2=0. More complex Mode S installations report additional capabilities in various formats assigned to BDS2 codes other than "0" as requested by interrogator, specified in the RRS subfield of SD.
	CFS	4	41-44		X	Continuation subfield contains the BDS2 value of the next additional capability report available from the installation.
	ECS	8	81-88		X	Data Link Capability subfield reports the ELM capability of the installation. If all bits are "0", no ELM data link services are supported.
	RAC	4	55-58		X	Resolution Advisory Complements subfield indicates currently active resolution advisory complements (if any) received from all other TCAS aircraft with on-board resolution capability. Bits are set to "1" when active and "0" when inactive. Bit indications are: 55-Don't descend. 56-Don't climb. 57-Don't turn right. 58-Don't turn left.
MC		80	9-88	X		Comm-C field contains one segment of a sequence of segments transmitted to the transponder in the ELM mode. MC is part of UF=24.

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
MC	SRS	16	9-24	X		If a Comm-C interrogation (UF=24) contains RC=3, the SRS subfield contains a list of segment request-authorizations in the 16-bit (9-24) SRS subfield. Starting with bit 9, denoting the first segment, each of the following bits is set to "1" if the transmission of the corresponding segment is requested.
MD		80	9-88		X	Comm-D field, part of DF=24, contains one segment of a sequence of segments transmitted by the transponder in the ELM mode. It may contain a summary of received MC segments of an uplink ELM.
	TAS	16	17-32		X	Reports the segments received so far in a Comm-C sequence. Starting with bit 17, denoting number "0", each of the following bits is "1" if the corresponding segment of the sequence has been received. TAS appears in MD if KE=1 in the same reply.
MU		56	33-88	X		Field, part of the long air-air surveillance interrogation UF=16, contains information used in air-to-air exchanges (TCAS Resolution Messages and TCAS Broadcast Messages).
	CHC	3	47-49	X		Cancel Horizontal Resolution Advisory Complement. In TCAS Resolution Messages transmitted by TCAS without horizontal resolution capability, CHC is set to "0". The codes are: 0 = No cancellation. 1 = Cancel, don't turn left. 2 = Cancel, don't turn right. 3-7 = Not assigned.
	CVC	2	43-44	X		Cancel Vertical Resolution Advisory Complement. The codes are: 0 = No cancellation. 1 = Cancel, don't descend. 2 = Cancel, don't climb. 3 = Not assigned.

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
MU	HRC	3	50-52	X		Horizontal Resolution Advisory Complement. In TCAS Resolution Messages transmitted by TCAS without horizontal resolution capability, HRC is set to "0". The codes are: 0 = No horizontal resolution advisory complement sent. 1 = Intruder TCAS sense is turn left/do not turn left. 2 = Intruder TCAS sense is turn left/do not turn right. 3-4 = Not assigned. 5 = Intruder TCAS sense is turn right/do not turn left. 6 = Intruder TCAS sense is turn right/do not turn right. 7 = Not assigned.
	HSB	5	56-60	X		Encoded Sense Bits for Horizontal Resolution Complements provide a parity coding field protecting the six horizontal sense bits (CHC and HRC) and is used in TCAS III Resolution Messages.
	MID	24	65-88	X		Contains the discrete address of the interrogating aircraft and is included in TCAS Resolution Messages and TCAS Broadcast Messages. **NOTE:** TCAS Broadcast Messages are sent at 10-second intervals.
	MTB	1	42	X		Multiple Threat Bit indicates more than one TCAS threat when set to "1" and no more than one threat when set to "0".
	UDS	8	33-40	X		Defines the content of the MU message field and is expressed in two 4-bit groups, UDS1 (33-36) and UDS2 (37-40).
	UDS1	4	33-36	X		Is set to "3" for TCAS Resolution Messages and TCAS Broadcast Messages.
	UDS2	4	37-40	X		Is set to "0" for TCAS Resolution Messages and set to "2" for TCAS Broadcast Messages.

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
MU	VRC	2	45-46	X		Vertical Resolution Advisory Complement. The codes are: 0 = No vertical resolution advisory complement sent. 1 = Don't descend. 2 = Don't climb. 3 = Not assigned.
	VSB	4	61-64	X		Encoded Sense Bits for Vertical Resolution Complements provide a parity coding field protecting the four vertical sense bits (CVC and VRC) and is sent in all TCAS Resolution Messages. If bits 43-46 do not agree with bits 61-64, as shown, the TCAS receiver assumes there is an error and disregards message. Bits are set as follows:
MV		56	33-88		X	Field, part of the long air-air surveillance reply DF=16, contains information used in air-to-air exchanges (Coordination Reply Message).

43	44	45	46	61	62	63	64
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	0
0	0	1	0	0	1	1	1
0	0	1	1	1	0	0	1
0	1	0	0	1	0	1	1
0	1	0	1	0	1	0	1
0	1	1	0	1	1	0	0
0	1	1	1	0	0	1	0
1	0	0	0	1	1	0	1
1	0	0	1	0	0	1	1
1	0	1	0	1	0	1	0
1	0	1	1	0	1	0	0
1	1	0	0	0	1	1	0
1	1	0	1	1	0	0	0
1	1	1	0	0	0	0	1
1	1	1	1	1	1	1	1

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
MV	ARA	14	41-54		X	Same as in MB field.
	CLI	1	59		X	Same as in MB field.
	RAC	4	55-58		X	Same as in MB field.
	VDS	8	33-40		X	Defines the content of the MV message field and is expressed in two 4-bit groups, VDS1 (33-36) and VDS2 (37-40).
	VDS1	4	33-36		X	Is set to "3" for Coordination Reply Message.
	VDS2	4	37-40		X	Is set to "0" for Coordination Reply Message.
NC		4	5-8	X		Provides the number of the segment transmitted in an uplink ELM and is part of a Comm-C interrogation, UF=24.
ND		4	5-8		X	Provides the number of the segment transmitted in an downlink ELM and is part of a Comm-D reply, DF=24.
PC		3	6-8	X		Contains operating commands to the transponder and is part of surveillance and Comm-A interrogations UF=4, 5, 20, 21. The codes are: 0 = No changes in transponder state. 1 = Non-selective All-Call lockout. 2 = Not assigned. 3 = Not assigned. 4 = Cancel B 5 = Cancel C 6 = Cancel D 7 = Not assigned.
PI		24	33-56		X	Contains the parity overlaid on the interrogator identity code. PI is part of the reply to Mode S-Only All-Call, DF=11.

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP DOWN	CONTENT
PR		4	6-9	X	Field contains commands to the transponder specifying the reply probability to the Mode S-Only All-Call interrogation, UF=11 that contains the PR. A command to disregard any lockout state can also be given. The assigned codes are: 0 = Reply with probability = 1. 1 = Reply with probability = 1/2. 2 = Reply with probability = 1/4. 3 = Reply with probability = 1/8. 4 = Reply with probability = 1/16. 5, 6, 7 = Do not reply. 8 = Disregard lockout, reply with probability = 1. 9 = Disregard lockout, reply with probability = 1/2. 10=Disregard lockout, reply with probability = 1/4. 11=Disregard lockout, reply with probability = 1/8. 12=Disregard lockout, reply with probability = 1/16. 13, 14, 15 = Do not reply. **NOTE:** On receipt of a Mode S-Only All-Call containing a PR code other than 0 or 8, transponder executes a random process and makes a reply decision for the interrogation in accordance with the commanded probability. Random occurrence of replies enables interrogator to acquire closely spaced aircraft when replies would otherwise synchronously garble each other.
RC		2	3,4	X	Designates the transmitted segment as initial, intermediate or final if coded "0", "1" or "2" respectively. RC=3 is used to request Comm-D downlink action by the transponder. RC is part of the Comm-C interrogation, UF=24.

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
RI		4	14-17		X	Information in DF=0, 16. The codes are: 0 = No on-board TCAS. 1 = Not assigned. 2 = On-board TCAS with resolution capability inhibited. 3 = On-board TCAS with vertical-only resolution capability. 4 = On-board TCAS with vertical and horizontal resoulution capability. 5-7 = Not assigned. 8 = No maximum airspeed data available. 9 = Airspeed is ≤75 kts. 10=Airspeed is >75 kts and ≤150 kts. 11=Airspeed is >150 kts and ≤300 kts. 12=Airspeed is >300 kts and ≤600 kts. 13=Airspeed is >600 kts and ≤1200 kts. 14=Airspeed is >1200 kts. 15=Not assigned.
RL		1	9	X		Command, sent in UF=0, 16; solicits DF=0 reply, if "0" and DF=16 reply, if "1" (only if transponder is associated with Airborne Collision Avoidance System [ACAS] equipment). Otherwise, in UF=0, "0" solicits DF=0 reply and "1" solicits no reply. In UF=16, "0" solicits DF=16 reply and "1" solicits no reply.
RR		5	9-13	X		Contains length and content of reply requested by the interrogator. RR is part of the surveillance and Comm-A interrogations UF=4, 5, 20, 21.

RR CODE	REPLY LENGTH	MB CONTENT
0-15	Short	NA
16	Long	Air initiated Comm-B
17	Long	Data link capability
18	Long	Aircraft Identification
19	Long	Resolution Advisories
20-31	Long	Not Assigned

NOTE: If first bit of RR code is "1", decimal equivalent of last four bits of RR code designates code for BDS1 in reply (ground initiated) BDS2 is assumed to be "0" if not specified by DI=7 and RRS.

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP DOWN	CONTENT
SD		16	17-32	X	Contains control codes, as specified by the DI field, affecting transponder protocol and is part of surveillance and Comm-A interrogations UF=4, 5, 20 and 21.
	IIS	4	17-20	X	Interrogator Identifier subfield contains the self-identification code of the interrogator and is numerically identical to the II code transmitted by the interrogator in the Mode S Only All-Call. IIS codes are assigned to interrogators and range from 0 through 15; IIS=0 is not a valid interrogator identifier for multisite purposes. IIS is sent only when DI=0, 1 or 7.
	LOS	1	26	X	Lockout subfield, if set to "1", initiates a multisite All-Call lockout to Mode S-Only All-Calls (UF=11) from the Interrogator indicated in IIS of the interrogation. If LOS is set to "0", no change in lockout state is commanded. LOS is sent only if DI=1 or 7.
	MBS	2	21-22	X	Multisite Comm-B subfield, sent when DI=1, is assigned the following codes: 0 = No Comm-B action. 1 = Comm-B reservation. 2 = Comm-B closeout.
	MES	3	23-25	X	Multisite ELM subfield, sent when DI=1, contains reservation and closeout commands for ELM as follows: 0 = No ELM action. 1 = Comm-C reservation. 2 = Comm-C closeout. 3 = Comm-D reservation. 4 = Comm-D closeout. 5 = Comm-C reservation and Comm-D closeout. 6 = Comm-C closeout and Comm-D reservation. 7 = Comm-C and Comm-D closeouts.
	RRS	4	21-24	X	Reply Request subfield, sent when DI=7, contains coding corresponding to the requested BDS2 code.

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP DOWN	CONTENT
SD	RSS	2	27,28	X	Reservation Status subfield, sent when DI=1, requests the transponder to report the reservation status in the UM field. The codes are: 0 = No request. 1 = Report Comm-B reservation status. 2 = Report Comm-C reservation status. 3 = Report Comm-D reservation status.
	TMS	4	29-32	X	Tactical Message subfield, sent when, DI=1 or 7, contains coding for the linking of Comm-A message segments. The codes are: 0 = No Action. 1 = Unlinked, Priority. 2 = Unlinked, Acknowledge. 3 = Unlinked, Priority, Acknowledge. 4 = Linked 1st Segment, Single ADS. 5 = Linked 1st Segment, Single ADS Priority. 6 = Linked 1st Segment, Single ADS Acknowledge. 7 = Linked 1st Segment, Single ADS, Priority, Acknowledge. 8 = Linked 1st Segment, Multiple ADS. 9 = Linked 1st Segment, Multiple ADS, Priority. 10=Linked 1st Segment, Multiple ADS, Acknowledge. 11=Linked 1st Segment, Multiple ADS, Priority, Acknowledge. 12=Second Segment. 13=Third Segment. 14=Final Segment. 15=Not Assigned.

Overview of Format Definitions
Table 3 (Cont)

FIELD	SUB FIELD	NO. OF BITS	BITS POSITION	FORMATS UP	FORMATS DOWN	CONTENT
SL		3	9-11		X	Reports the sensitivity level the TCAS unit is currently operating at, and is a part of air-air surveillance replies, DF=0, 16. The codes are: 0 = No TCAS sensitivity level reported. 1 = TCAS operates at sensitivity level 1. 2 = TCAS operates at sensitivity level 2. 3 = TCAS operates at sensitivity level 3. 4 = TCAS operates at sensitivity level 4. 5 = TCAS operates at sensitivity level 5. 6 = TCAS operates at sensitivity level 6. 7 = TCAS operates at sensitivity level 7. **NOTE:** The SL field has no meaning for aircraft with RI=0 (no on-board capability to generate resolution advisories).
UF		5	1-5	X		The first field in all uplink formats is the transmission descriptor in all interrogations.
UM		6	14-19		X	Contains transponder status readouts in replies DF=4, 5, 20, 21.
	IDS	2	18,19		X	Identifier Designator subfield reports the type of reservation made by the interrogator identified in IIS and corresponds with the RSS subfield of SD. Assigned coding is: 0 = No information available. 1 = Comm-B reservation active. 2 = Comm-C reservation active. 3 = Comm-D reservation active.
	IIS	4	14-17		X	Interrogator Identifier subfield reports the identity of the interrogator that has made a multisite reservation.
VS		1	6		X	Indicates "0" when aircraft is airborne and "1" when aircraft is on the ground. VS is a part of DF=0, 16.

Overview of Format Definitions
Table 3 (Cont)

				b5	0	0	1	1
				b6	0	1	0	1
b4	b3	b2	b1					
0	0	0	0			P	SP	0
0	0	0	1		A	Q		1
0	0	1	0		B	R		2
0	0	1	1		C	S		3
0	1	0	0		D	T		4
0	1	0	1		E	U		5
0	1	1	0		F	V		6
0	1	1	1		G	W		7
1	0	0	0		H	X		8
1	0	0	1		I	Y		9
1	0	1	0		J	Z		
1	0	1	1		K			
1	1	0	0		L			
1	1	0	1		M			
1	1	1	0		N			
1	1	1	1		O			
SP = SPACE code								

6-Bit Character Set for AIS Subfield
Table 4

CHAPTER ONE

MODE S TEST SYSTEM

OPERATION MANUAL

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SECTION 1- DESCRIPTION

1. General Description and Capabilities

A. Description

The S-1403C/ATC-1400A (Mode S Test System) simulates an ATCRBS/Mode S equipped Secondary Surveillance Radar (SSR) ground station. The Mode S Test System provides pulse and Differential Phase Shift Keying (DPSK) modulated signals for testing Air Traffic Control Radar Beacon System (ATCRBS) and Mode Select (Mode S) Transponders. Operation is accomplished manually using front panel controls and switches, or remotely by Automatic Test Equipment (ATE) control through the General Purpose Interface Bus (GPIB) Connector.

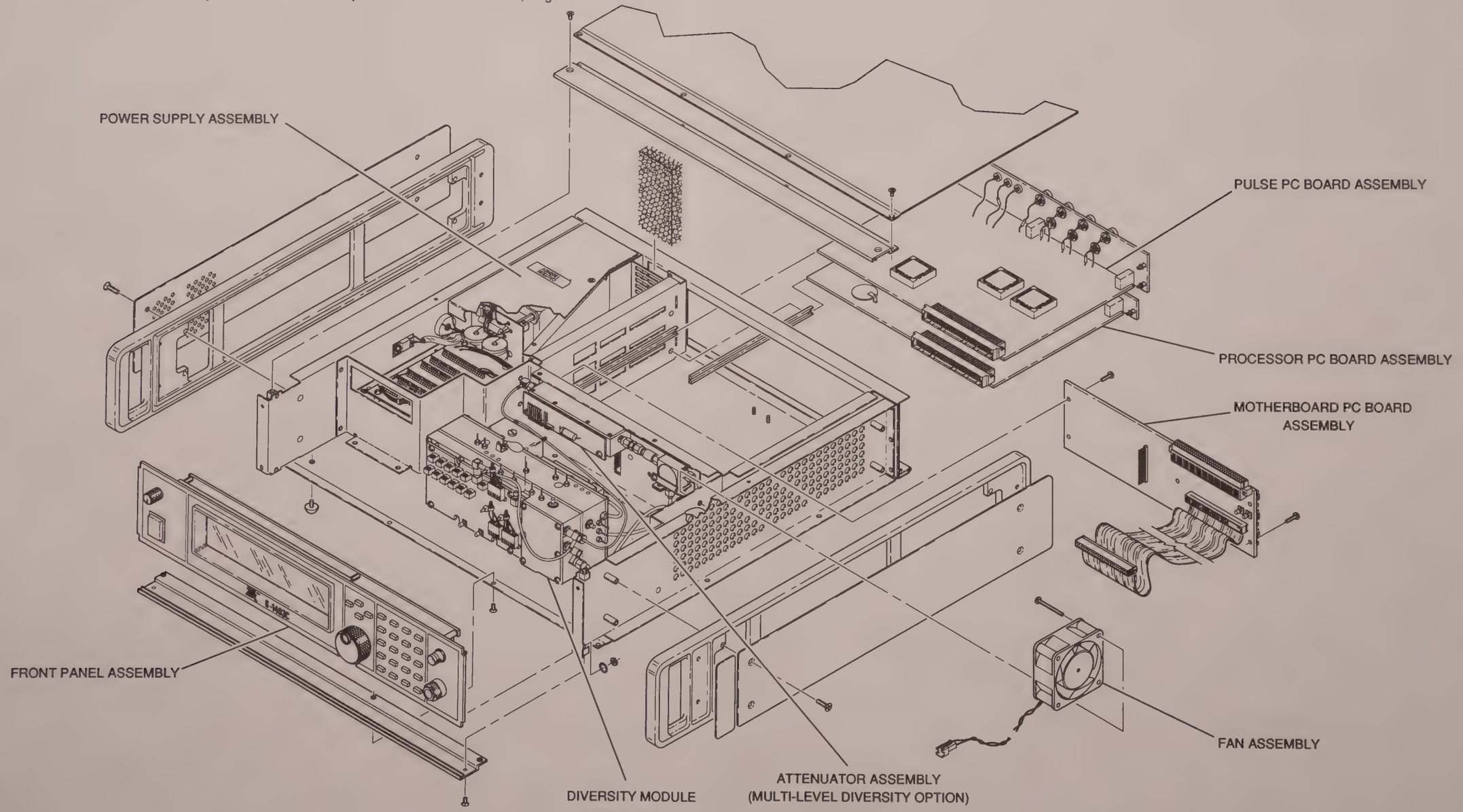
B. Functional Capabilities

The Mode S Test System incorporates the following features and capabilities:

- ATCRBS (ATC) Test Function
- Mode S Sequence (SEQ) Test Function
- ATCRBS Only All-Call (All-Call Short [ACS]) Test Function
- ATCRBS/Mode S All-Call (All-Call Long [ACL]) Test Function
- Interlacing (INTLCE) Mode S with ATC Test Function
- Double Interrogation (DI) Test Function
- BURST Test Function
- RF output at a fixed frequency and output level for diversity antenna testing
- Four-line by 40-column indicator for displaying Mode S parameters
- 24 control keys for numerical data entry, function selection and cursor control
- Continuous rotation "SLEW" Control used as an alternate to key entry
- Programmable 16-item sequence for uplink and downlink format information
- Battery backup memory for saving two sets of S-1403C test functions
- P_4 and P_6 width and offset; P_4 and P_5 amplitude control
- Synchronous Phase Reversal (SPR) offset control
- Remote operation through the ATC-1400A IEEE-488 1978 interface connector
- Rear panel interconnects for control and signal monitoring

C. Mechanical Description

The S-1403C Test Auxiliary mechanical description is shown in 1-1-1, Figure 1.



S-1403C Composite
Figure 1

SECTION 2 - OPERATION

1. Installation

A. General

The Mode S Test System is a bench test set requiring continuous ac power to operate. Installation of the Mode S Test System includes connecting the S-1403C Test Auxiliary with the ATC-1400A Transponder/DME Test Set, powering up the system and accomplishing a pre-operational system calibration.

Refer to 1-2-2, Figure 6 for S-1403C controls, connectors and indicators called out in 1-2-1 (alphabetic characters). Refer to 1-2-2, Figure 17 for ATC-1400A controls, connectors and indicators called out in 1-2-1 (numeric characters).

B. Safety Precautions

The following safety precautions must be observed during installation and operation. IFR Systems, Inc. assumes no liability for failure to comply with any safety precaution outlined in this manual.

(1) Complying with Instructions

Installation/operating personnel should not attempt to install or operate the Mode S Test System without reading and complying with instructions contained in this manual. All procedures contained in this manual must be performed in exact sequence and manner described.

(2) Grounding Equipment and Power Cord

WARNING: ALL EQUIPMENT CHASSIS CABINETS MUST BE CONNECTED TO AN ELECTRICAL GROUND TO MINIMIZE SHOCK HAZARD.

WARNING: DUE TO POTENTIAL SAFETY HAZARDS, USE OF THREE-PRONG TO TWO-PRONG ADAPTOR PLUG(S) IS NOT RECOMMENDED.

The power cord is equipped with standard three-prong plug which must be connected to a properly grounded three-prong wall receptacle. It is the customer's responsibility to:

- Have qualified electrician check wall receptacle(s) for proper grounding.
- Replace any standard two-prong wall receptacle(s) with properly grounded three-prong receptacle(s).

(3) Operating Safety

Due to potential for electrical shock within test equipment, remove covers only when performing the Installation Calibration in 1-2-1F. Use common sense and caution when working around test equipment with the covers removed. Component replacement and internal adjustments must be made by qualified personnel only. Refer to Mode S Test System Maintenance Manual for maintenance procedures.

(4) CAUTION and WARNING Labels

Exercise extreme care when performing operations preceded by a CAUTION or WARNING label. CAUTION labels appear where possibility of damage to equipment exists. WARNING labels denote conditions where bodily injury or death may result.

C. Power Requirements

The Mode S Test System operates over a voltage range of 105 to 120 or 210 to 250 VAC (at 50 to 400 Hz). No internal wiring changes are required before applying ac power to the Test Auxiliary. Ensure LINE SELECT Switch (N) setting on S-1403C rear panel matches input line voltage. Instantaneous surge current at power up is <50 A. Input current varies to maintain constant power over the input voltage range (approximately 30 W), so it is important the fuses selected have the correct rating for proper operation. Recommended fuse ratings are listed in 1-2-1, Table 1.

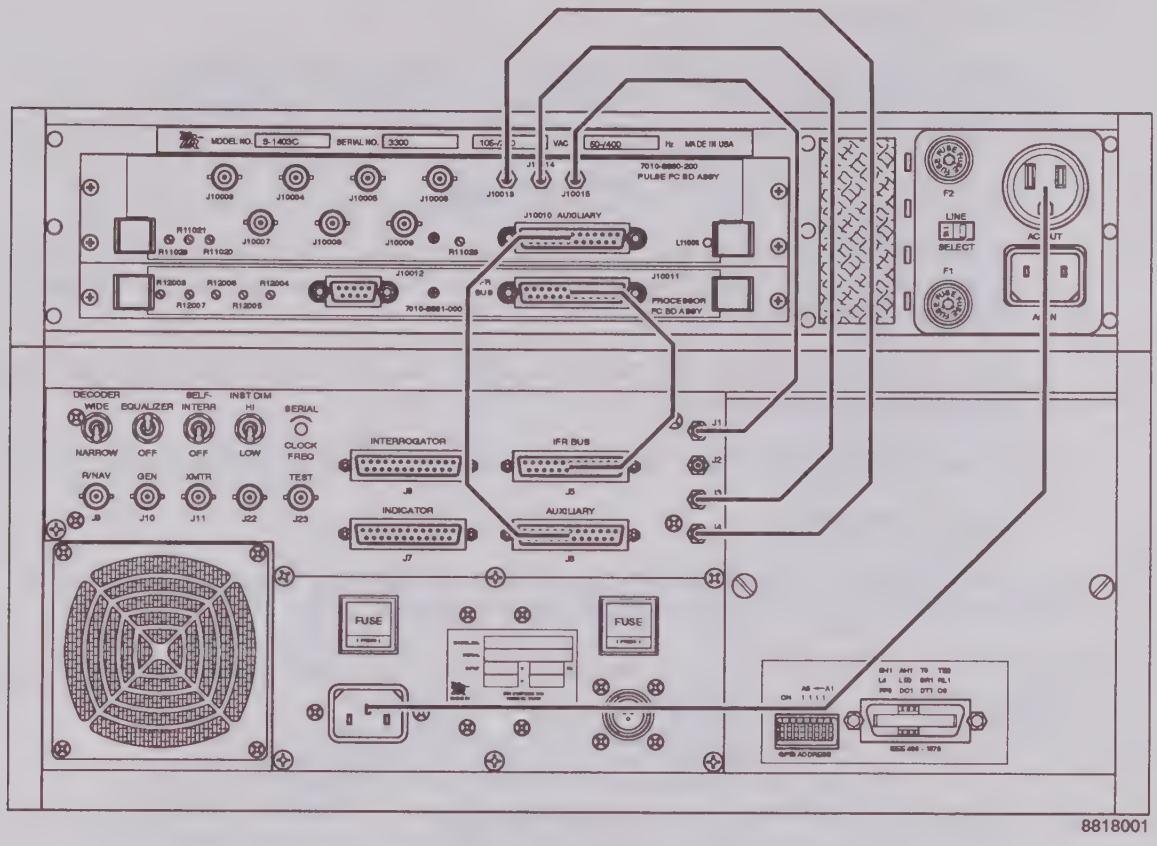
CAUTION: F2 - LINE SUPPLY FUSE HAS A CRITICAL TIME DELAY AND MUST BE REPLACED WITH A PROPERLY TIMED FUSE TO AVOID POSSIBLE DAMAGE TO THE S-1403C TEST AUXILIARY.

INPUT VOLTAGE	F1 - AC IN FUSE	F2 - LINE SUPPLY FUSE
105 to 120 VAC	3.0 A, 250 V Fast Blo (IFR PN: 5106-0300-600) (Bussman AGC3)	0.5 A, 250 V Reg Blo (IFR PN: 5106-0000-026) (Bussman MDL1/2)
220 to 250 VAC	3.0 A, 250 V Fast Blo (IFR PN: 5106-0300-600) (Bussman AGC3)	0.25 A, 250 V Reg Blo (IFR PN: 5106-0000-025) (Bussman MDL1/4)

Recommended Fuse Ratings
Table 1

D. Installation Procedure

STEP	PROCEDURE
1.	Place ATC-1400A on bench.
2.	Place S-1403C on top of ATC-1400A.
3.	Connect two 25-pin type D ribbon cables and three SMB-to-SMB coaxial cables to Test Sets as shown in 1-2-1, Figure 1.
4.	Connect ATC-1400A ac power cable as shown in 1-2-1, Figure 1.
5.	Perform Power-up Procedure according to 1-2-1E.
6.	Calibrate Mode S Test System according to 1-2-1F. Perform Installation Calibration any time S-1403C or ATC-1400A is replaced.



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S-1403C to ATC-1400A Interconnections
Figure 1

The Mode S Test System can be installed in either bench-top or rack-mount fashion. All IFR Systems, Inc., test sets are normally shipped from the factory with plastic feet installed for bench-top installation. Kits required are listed in 1-2-1, Table 2.

KIT REQUIRED	INSTRUMENT	IFR SYSTEMS PART NUMBER
Rack-Mount	ATC-1400A S-1403C	7001-7636-800 7001-6740-800
Bench-Top/Stack-Mount	ATC-1400A S-1403C	7005-6743-000 One kit required per Mode S System

Installation Kits
Table 2

CAUTION: SPECIAL CARE MUST BE TAKEN TO AVOID RESTRICTION OF AIR FLOW TO INTAKE VENT WHEN INSTALLING INSTRUMENT IN EITHER BENCH-TOP OR RACK-MOUNT FASHION.

E. Power-up Procedure

The Mode S Test System is configured for one-touch power control. When the ATC-1400A LINE Switch (35) is ON, the S-1403C POWER Switch (G) controls power to the S-1403C Test Auxiliary and ATC-1400A Transponder/DME Test Set.

STEP	PROCEDURE

1. Connect female end of S-1403C ac power cable to AC IN Connector (L) on rear panel of S-1403C. Connect male end of ac power cable to standard 3-pin grounded power receptacle.

2. Press POWER Switch (G) ***ON*** to energize Test Auxiliary and verify POWER Switch (G) illuminates.

3. Press LINE Switch (35) ***ON*** and verify LINE Switch (35) illuminates.

F. Installation Calibration

The Mode S Test System Installation Calibration requires a calibrated S-1403C connected to a calibrated ATC-1400A according to 1-2-1D.

TEST EQUIPMENT: (Refer to Appendix C for Test Equipment Specifications.)

Heterodyne Monitor
Oscilloscope
Power Meter
RF Signal Generator
Spectrum Analyzer

CAUTION: THE FRONT PANEL ASSEMBLY, PULSE PC BOARD ASSEMBLY, PROCESSOR PC BOARD ASSEMBLY AND DIVERSITY MODULE CONTAIN PARTS SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). ALL PERSONNEL PERFORMING INSTALLATION CALIBRATION SHOULD HAVE KNOWLEDGE OF ACCEPTED ESD PRACTICES AND/OR BE ESD CERTIFIED.

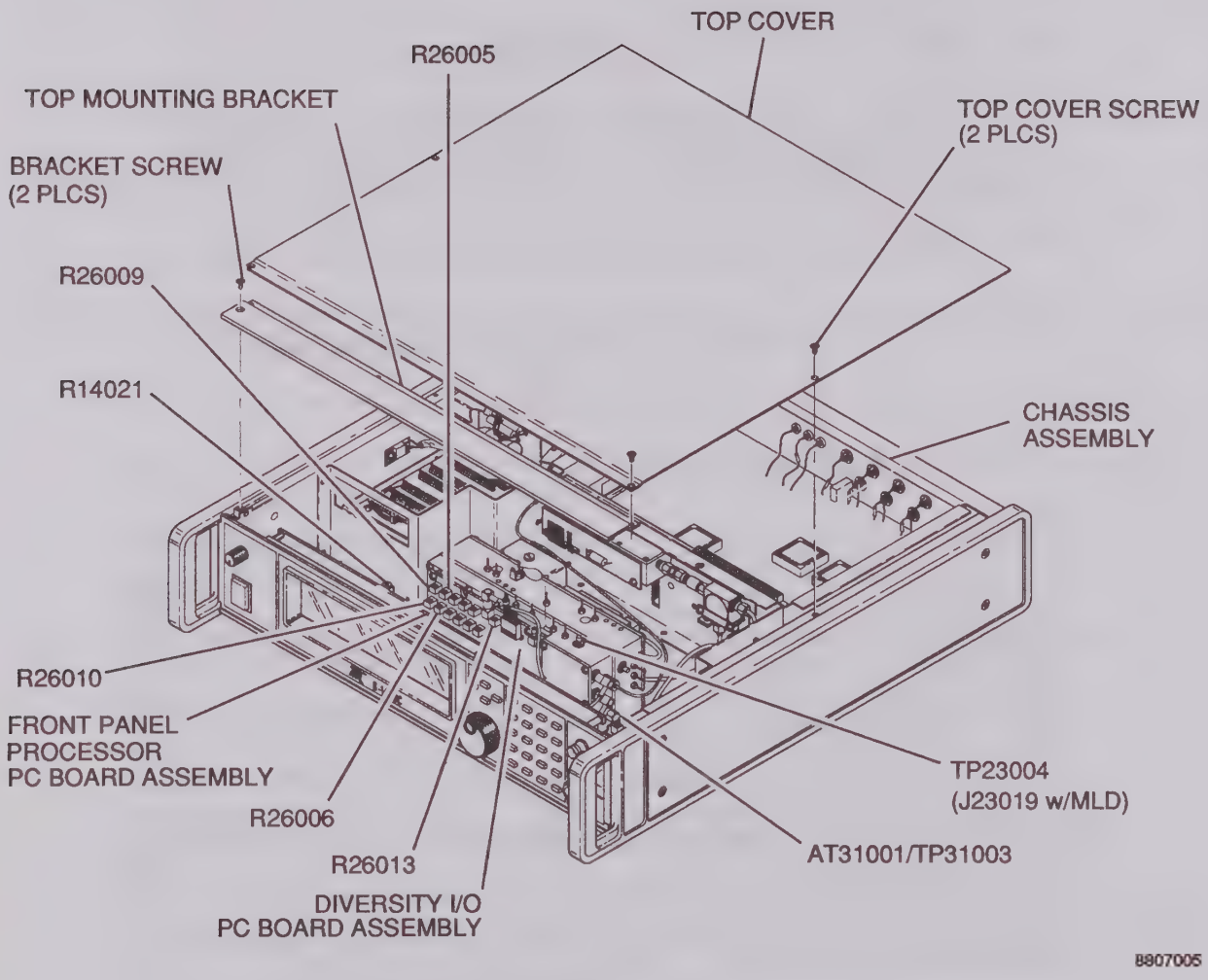
STEP	PROCEDURE

1. Remove power from S-1403C.

2. Remove two top cover screws and two bracket screws according to 1-2-1, Figure 2.

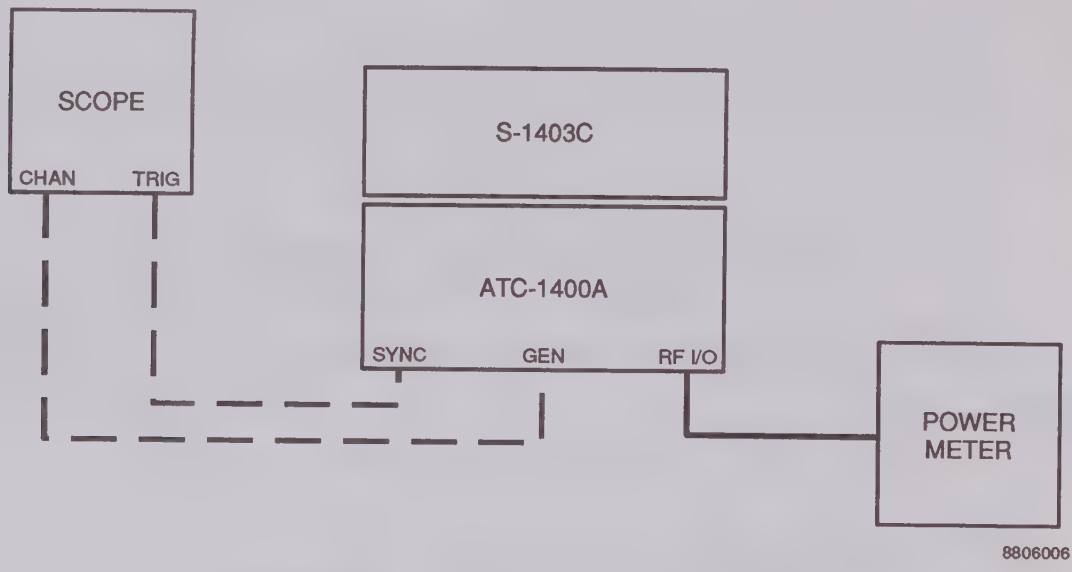
3. Lift top cover with top mounting bracket from Chassis Assembly. Refer to 1-2-1, Figure 2.

4. Apply power to Mode S Test System.



Installation Calibration Internal Adjustments
Figure 2

STEP PROCEDURE



Installation Calibration Test Setup #1 Diagram
Figure 3

5. Set ATC-1400A as follows:

CONTROL		SETTING
(7)	CW/NORM/OFF Switch	***NORM***
(18)	SLS/ECHO ON/OFF Switch	***OFF***
(22)	MAN/AUTO/MAN STEP Switch	***MAN***
(25)	XPDR DEV P_3/CAL Switch	***CAL***
(28)	XPDR DEV P_2/CAL Switch	***CAL***
(32)	PRF/SQTR ON/OFF Switch	***ON***
(37)	TACAN ON/OFF Switch	***OFF***
(41)	PRF/SQUITTER Thumbwheels	***0200***
(42)	DBL INTERR/INTRF Thumbwheels	***000.0 OFF***
(45)	FREQ/FUNCTION SELECT Thumbwheels	***1030 XPDR***
(48)	ΔF Thumbwheels	***OFF***

6. Verify S-1403C Control Menu #1 with ***Func: (1) ATC*** is displayed after approximately 30 seconds.

7. Use CURSOR Keys (A) and position cursor to ***RFLvl:*** field.

8. Use Keyboard (B) or SLEW Control (F) to set ***RFLvl:+0.0***.

9. Adjust RF LEVEL Control (6) to read ***00*** on the RF LEVEL -dBm Display (3).

10. Disconnect cable from RF VERNIER OUT Connector (J10013) (GG).

11. Set CW/NORM/OFF Switch (7) to ***CW***.

STEP PROCEDURE

12. Connect Power Meter (through Power Sensor) to RF I/O Connector (9) as shown in 1-2-1, Figure 3. Record Power Meter reading.

13. Reconnect cable to RF VERNIER OUT Connector (J10013) (GG) and adjust ZERO SCALE Adjust (R11023) (W) to reading recorded in Step 12.

14. Set S-1403C ***RFLvl:+3.0***.

15. Adjust FULL SCALE Adjust (R11021) (X) until Power Meter displays +3.0 dB more than reading recorded in Step 12.

16. Repeat Steps 12 through 15 until no adjustments are required. Verify Power Meter readings are within ±0.05 dBm of each other when cable to RF VERNIER OUT Connector (J10013) (GG) is connected or disconnected.

17. Verify Power Meter reading is -3 dBm (±0.2 dB) when ***RFLvl:*** field is set to -3.0 and +3 dBm (±0.2 dB) when ***RFLvl:*** field is set to +3.0.

18. Press 2ND, FUN NO and "2" Keys in sequence. Verify Control Menu #1 with ***Func: (2) SEQ*** is displayed.

19. Press S MENU Key. Verify Sequence Menu S01 is displayed.

20. Rotate SLEW Control (F) through each sequence menu and press ON/CAL Key to set sequences S02 through S16 OFF.

21. Use CURSOR Keys (A), Keyboard (B) and SLEW Control (F) to set ***S01:FMT D,UF#04*** and ***ADD=17725762***.

22. Press C MENU and "1" Keys in sequence. Verify Control Menu #1 with ***Func: (2) SEQ*** is displayed.

23. Use CURSOR Keys (A) and ON/CAL Key to set ***AntB: ON***.

24. Set CW/NORM/OFF Switch (7) to ***NORM***.

25. Connect GEN Connector (15) to Oscilloscope. Refer to 1-2-1, Figure 3.

26. Connect SYNC Connector (29) to Ext Trigger Input of Oscilloscope. Refer to 1-2-1, Figure 3.

27. Set T_O/TAC/T_D Switch (30) to ***T_O***.

28. Adjust DPSK AMPLITUDE BALANCE Adjust (R11026) (P) until P_6 phase shift peaks are relatively even.

29. Rotate ATC-1400A RF LEVEL Control (6) until -50 dBm (-20 dBm if the Multi-Level Diversity option is installed) is displayed on RF LEVEL -dBm Display (3).

30. Set CW/NORM/OFF Switch (7) to ***CW***.

31. Disconnect Power Meter from RF I/O Connector (9).

STEP PROCEDURE

32. Connect Spectrum Analyzer to RF I/O Connector (9).

33. Set ***RFLvl:+0.00***.

34. Set Spectrum Analyzer controls as follows:

CONTROL	SETTING
Span	Zero
Bandwidth	3 MHz
Sweep Rate	5 or 10 µs
Log Scale	1 or 2 dB/Div

35. Set CW/NORM/OFF Switch (7) to ***NORM***.

36. Adjust Spectrum Analyzer for stable display and record signal level as a reference.

    NOTE: Steps 37 and 38 only apply if the Multi-Level Diversity option is installed.

37. Press C MENU and "2" Keys in sequence. Verify Control Menu #2 is displayed.

38. Set ***Brf= -20 dBm*** and ***BrfIv=+0.0 dB***.

39. Disconnect Spectrum Analyzer from RF I/O Connector (9) and connect Spectrum Analyzer to ANT B Connector (E).

40. Refer to 1-2-1, Figure 2 and adjust R26013 on the S-1403C Diversity I/O PC Board Assembly to set Spectrum Analyzer signal at reference level recorded in Step 36 (±0.5 dB).

    NOTE: Steps 41 through 49 only apply if the Multi-Level Diversity option is installed.

41. Set CW/NORM/OFF Switch (7) to ***CW***.

42. Disconnect Spectrum Analyzer from ANT B Connector (E).

43. Connect Power Meter to ANT B Connector (E).

44. Verify Power Meter reading is -20 dBm (±1 dB). Record signal level for a reference.

45. Set ***BrfIv= +3.0 dB***. Verify Power Meter reading is reference level from Step 44 + 3.0 dB (±0.3 dB). If not, adjust R14021 on Front Panel Processor PC Board Assembly. Refer to 1-2-1, Figure 2.

46. Set ***BrfIv=+0.0 dB***. Verify Power Meter reading equals reference from Step 44 (±0.05 dB). If not, adjust R26013 on Diversity I/O PC Board Assembly. Refer to 1-2-1, Figure 2.

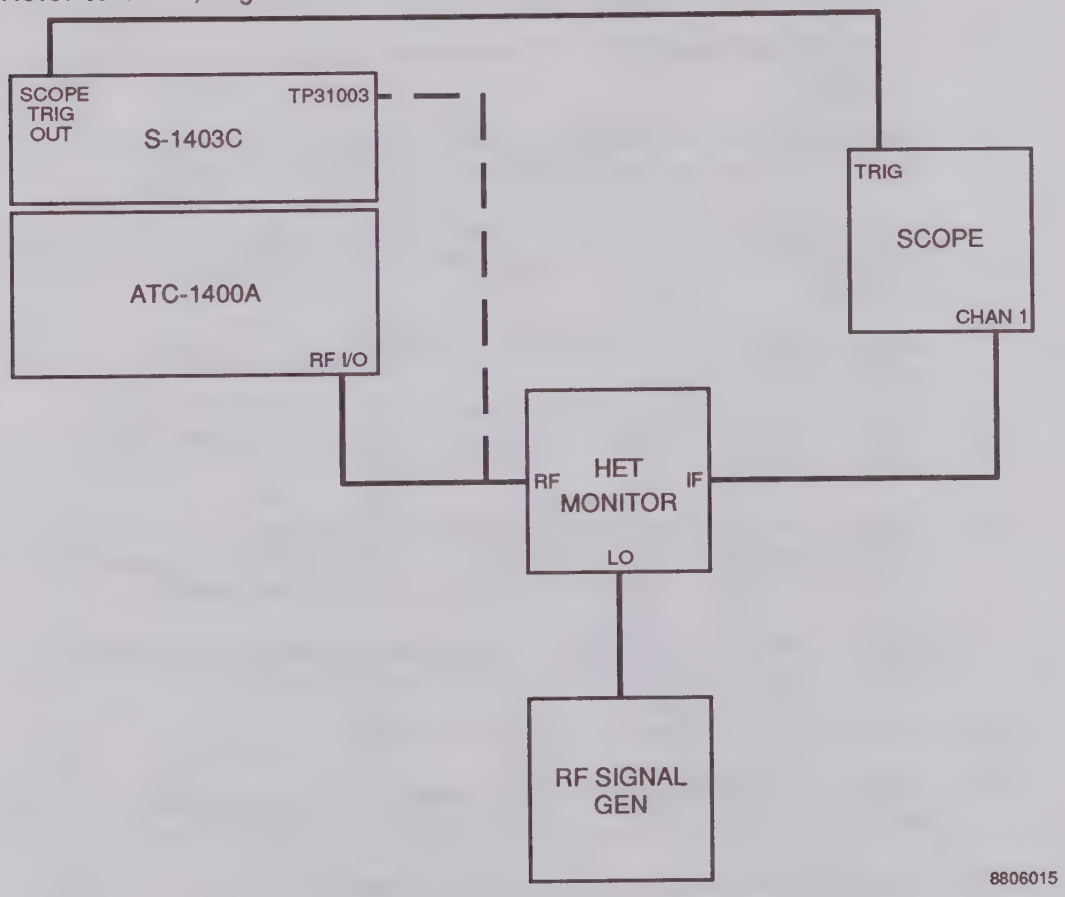
STEP PROCEDURE

47. Repeat Steps 45 and 46 until +3 dB and 0 dB settings are within tolerance without adjustments.

48. Set ***Brflv= -3.0 dB***. Verify Power Meter reading is reference level from Step 44 - 3.0 dB (±0.3 dB).

49. Disconnect Oscilloscope and Power Meter from Mode S Test System.

50. Connect Oscilloscope External Trigger to SCOPE TRIG OUT Connector (AA). Refer to 1-2-1, Figure 4.



Installation Calibration Test Setup #2 Diagram
Figure 4

51. Connect Oscilloscope Channel 1 to Heterodyne Monitor IF Connector. Refer to 1-2-1, Figure 4.

52. Connect Heterodyne Monitor RF Connector to RF I/O Connector (9). Refer to 1-2-1, Figure 4.

53. Connect RF Signal Generator, set for 1030 MHz at +6 dBm, to Heterodyne Monitor LO Connector. Refer to 1-2-1, Figure 4.

STEP PROCEDURE

54. Set CW/NORM/OFF Switch (7) to ***NORM***.

55. Press C MENU and "1" Keys in sequence. Verify Control Menu #1 with ***Func: (2) SEQ*** is displayed.

56. Adjust SPR TIMING Adjust (R12007) (U) until 50% point of P_2 leading edge to SPR center point spacing is between 2.70 and 2.75 µs.

57. Refer to 1-2-1, Figure 5 and set JTB11001 on Pulse PC Board Assembly until 50% point of P_2 leading edge to SPR center point is spaced 2.75 µs (±10 ns).

58. Align 50% point of P_1 (Ant A) with major vertical axis on Oscilloscope for reference.

59. Disconnect Heterodyne Monitor RF Connector from RF I/O Connector. Reconnect Heterodyne Monitor RF Connector to TP31003.

60. Adjust JTB11002 followed by R26010 on Diversity I/O PC Board Assembly to align P_1 with major vertical axis. Refer to 1-2-1, Figure 5 for JTB11002 location.

61. Adjust R26009 on Diversity I/O PC Board Assembly for P_1 pulse width of 800 ns (±10 ns)

62. Verify all sequences are off except for ***S01:FMT D,UF#04*** with ***ADD=17725762***.

63. Adjust JTB11003 followed by R26006 on Diversity I/O PC Board Assembly until 50% point of P_2 leading edge to SPR center point spacing is 2.75 µs (±10 ns). Refer to 1-2-1, Figure 5 for JTB11003 location.

64. Adjust R26005 on Diversity I/O PC Board Assembly until spacing between SPR and next phase transition is 1.0 µs (±10 ns).

65. Press 2ND, SAVE and "1" Keys in sequence.

66. Press POWER Switch (G) ***OFF***. After ≥30 seconds, press POWER Switch (G) ***ON***.

67. Press 2ND, RECALL and "1" Keys in sequence.

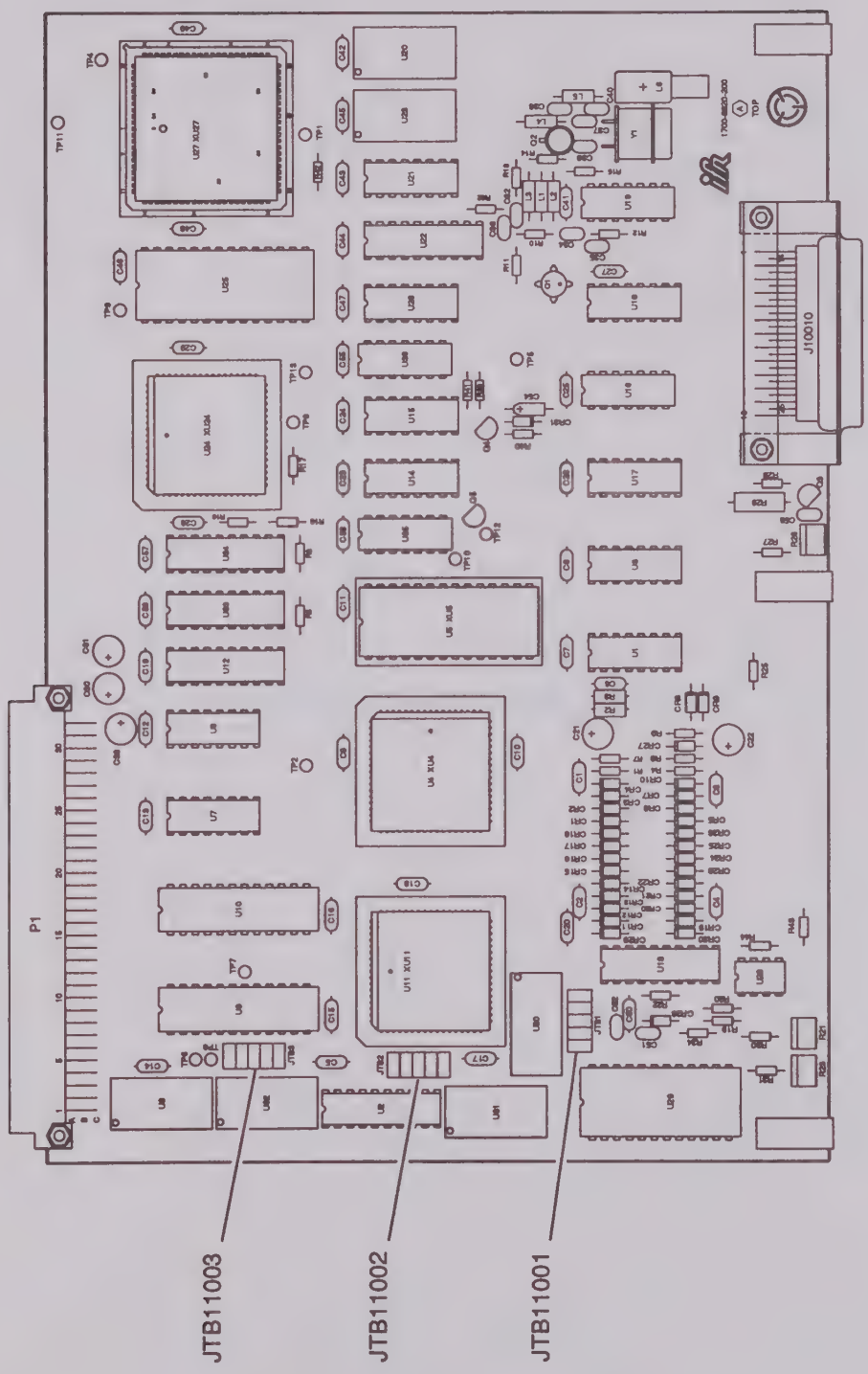
68. Verify P_2 to SPR is 2.75 µs (±25 ns).

69. Remove power from Mode S Test System.

70. Disconnect test equipment.

71. Place top cover with top mounting bracket on Chassis Assembly according to 1-2-1, Figure 2.

72. Tighten two top cover screws and two bracket screws shown in 1-2-, Figure 2.



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Pulse PC Board Assembly Installation Calibration
Figure 5

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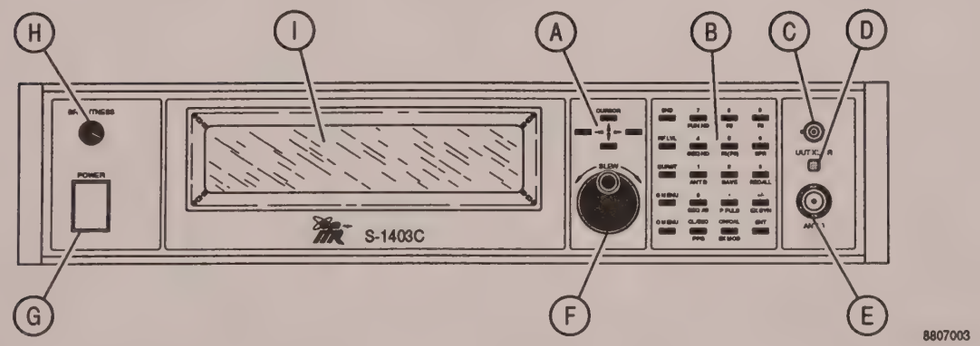
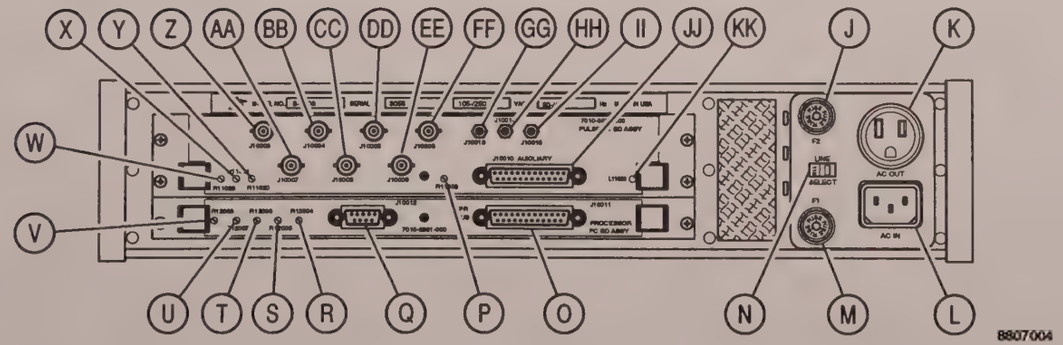
2. Description of Controls, Connectors and Indicators





A. CURSOR Keys
B. Keyboard
C. UUT XMTR Connector (J10001)
D. UUT XMTR Indicator
E. ANT B Connector (J10002)
F. SLEW Control
G. POWER Switch
H. BRIGHTNESS Control
I. MENU Display
J. F2 Fuse
K. AC OUT Connector
L. AC IN Connector
M. F1 Fuse
N. LINE SELECT Switch
O. IFR BUS Connector (J10011)
P. DPSK AMPLITUDE BALANCE Adjust (R11026)
Q. TEST Connector (J10012)
R. R12004
S. ANT B REPLY DELAY Adjust (R12005)
T. ANT A REPLY DELAY Adjust (R12006)
U. SPR TIMING Adjust (R12007)
V. R12003
W. ZERO SCALE Adjust (R11023)
X. FULL SCALE Adjust (R11021)
Y. REF VOLTAGE Adjust (R11020)
Z. EXT MOD IN Connector (J10003)
AA. SCOPE TRIG OUT Connector (J10007)
BB. EXT SYNC IN Connector (J10004)
CC. EXT SYNC OUT Connector (J10008)
DD. MODE S/ATCRBS DISCRETE OUT Connector (J10005)
EE. PREPULSE OUT Connector (J10009)
FF. ANT B VIDEO OUT Connector (J10006)
GG. RF VERNIER OUT Connector (J10013)
HH. MEASUREMENT GATE OUT Connector (J10014)
II. DPSK OUT Connector (J10015)
JJ. AUXILIARY Connector (J10010)
KK. 80 MHz Adjust (L11006)

S-1403C Front and Rear Panels
Figure 6

Refer to 1-2-2, Figure 6 for S-1403C controls, connectors and indicators (alphabetic character identifiers). Refer to 1-2-2, Figure 17 for ATC-1400A controls, connectors and indicators (numeric character identifiers).

A. S-1403C Front and Rear Panels (Refer to 1-2-2, Figure 6.)

ITEM	DESCRIPTION

A. CURSOR Keys (↑, →, ↓, ←)

Used to select data or control fields for editing. Cursor is shown as an underline below the selected field. After cursor is positioned under the desired field, the Keyboard (B) or SLEW Control (F) is used to edit the field.

B. Keyboard (Refer to 1-2-2B.)

Controls the microprocessor and is used for data entry. A Keyboard entry changes the character at the cursor position and advances the cursor to the next character in that field.

C. UUT XMTR Connector (J10001)

BNC type connector provides detected UUT transmission video received through ANT B Connector (E).

D. UUT XMTR Indicator

LED illuminates when transmitter replies are received through ANT B Connector (E).

E. ANT B Connector (J10002)

N type connector provides access to a second RF channel for diversity testing. The S-1403C transmits interrogation signals through ANT B Connector at a fixed power level unless the Multi-Level Diversity option is installed. The Multi-Level Diversity option provides level control over the signal transmitted through this connector.

F. SLEW Control

Selects data by rotating in either a cw or ccw direction. Entire command and decimal data fields are edited with one SLEW Control entry. Octal data fields are changed one character at a time. SLEW Control input allows rapid advance to desired function or data.

G. POWER Switch

Applies ac power to the S-1403C Test Auxiliary and AC OUT Connector (K).

H. BRIGHTNESS Control

Controls brightness of backlighting to MENU Display (I). Rotating control cw increases brightness and rotating control ccw decreases brightness.

ITEM DESCRIPTION

I. MENU Display

Displays menu as selected on the Keyboard (B). Refer to 1-2-2C for menu descriptions.

J. F2 Fuse

Fuses power to LINE SELECT Switch (N). When LINE SELECT Switch (N) is in 115 VAC position, F2 should be 1.0 A, 250 V Reg Blo. When LINE SELECT Switch (N) is in 230 VAC position, F2 should be 0.50 A, 250 V Reg Blo. Refer to 1-2-1C.

K. AC OUT Connector

Receptacle used for providing power to the ATC-1400A.

L. AC IN Connector

Receptacle used for application of 115 or 230 VAC single phase power to the S-1403C. LINE SELECT Switch (N) must be set to correct position before applying power.

M. F1 Fuse

Fuses power to the S-1403C and AC OUT Connector (K). F1 should be 3.0 A, 250 V Fast Blo. Refer to 1-2-1C.

N. LINE SELECT Switch

Selects the line voltage, 115 or 230 VAC, applied to the S-1403C.

O. IFR BUS Connector (J10011)

25-pin female connector provides communication and control data between the S-1403C and ATC-1400A through IFR BUS Connector (71). Refer to Appendix A for pin-out table.

P. DPSK AMPLITUDE BALANCE Adjust (R11026)

Used during calibration to set a consistent amplitude level for the Mode S interrogation phase reversals.

Q. TEST Connector (J10012)

For IFR Systems Inc. use only.

R. R12004

Not used.

ITEM DESCRIPTION

S. ANT B REPLY DELAY Adjust (R12005)

Used during calibration to set the reply delay measurement standard through ANT B Connector (E).

T. ANT A REPLY DELAY Adjust (R12006)

Used during calibration to set the reply delay measurement standard through RF I/O Connector (9).

U. SPR TIMING Adjust (R12007)

Used during calibration to set timing of the Synchronous Phase Reversal (SPR) occurring in Mode S interrogations.

V. R12003

Not used.

W. ZERO SCALE Adjust (R11023)

Used during calibration to set the zero reference for RF level control provided by the S-1403C.

X. FULL SCALE Adjust (R11021)

Used during calibration to set maximum RF level control provided by the S-1403C.

Y. REF VOLTAGE Adjust (R11020)

Not used.

Z. EXT MOD IN Connector (J10003)

Used to connect an external modulation source. External modulation is accepted any time regardless of Control Menu #2, ***Ext.Mod.In:*** field setting.

AA. SCOPE TRIG OUT Connector (J10007)

Provides a scope trigger for the interrogation or reply times and is controlled by the T_O/TAC/T_D Switch (30). Refer to Appendix A for trigger pulse position.

BB. EXT SYNC IN Connector (J10004)

Used to connect an external sync source. The EXT SYNC IN Connector is enabled from the S-1403C front panel (Control Menu #2) or by remote operation through the GPIB.

ITEM DESCRIPTION

CC. EXT SYNC OUT Connector (J10008)

Provides an external sync pulse and is controlled from the S-1403C front panel (Control Menu #2) or by remote operation through GPIB.

DD. MODE S/ATCRBS DISCRETE OUT Connector (J10005)

Provides an active low 3.0 µs long pulse with leading edge occurring 1.0 µs prior to the Prepulse output leading edge. The Mode S/ATCRBS Discrete pulse is only active when an ATCRBS interrogation is pending.

EE. PREPULSE OUT Connector (J10009)

Provides a 1.0 µs long TTL Prepulse and is controlled from the S-1403C front panel (Control Menu #2) or by remote operation through GPIB.

FF. ANT B VIDEO OUT Connector (J10006)

Provides a digital version of the ANT B reply signal viewed at UUT XMTR Connector (C).

GG. RF VERNIER OUT Connector (J10013)

SMB type connector provides an analog output signal for vernier control over the ATC-1400A RF output level.

HH. MEASUREMENT GATE OUT Connector (J10014)

SMB type connector provides a Pulse Power Measurement Gate (PPMG) pulse to the ATC-1400A. The pulse is controlled from the S-1403C front panel (Control Menu #2) or by remote operation through the GPIB. The PPMG pulse selects a specific ATCRBS or Mode S Reply pulse for UUT power and frequency measurements. Power measurements are displayed on XMTR PWR WATTS Display (1). Frequency measurements are displayed on XMTR FREQ MHz Display (51).

II. DPSK OUT Connector (J10015)

SMB type connector provides the DPSK modulation used in Mode S interrogations. The bipolar level signal through this connector drives the phase modulator in the ATC-1400A.

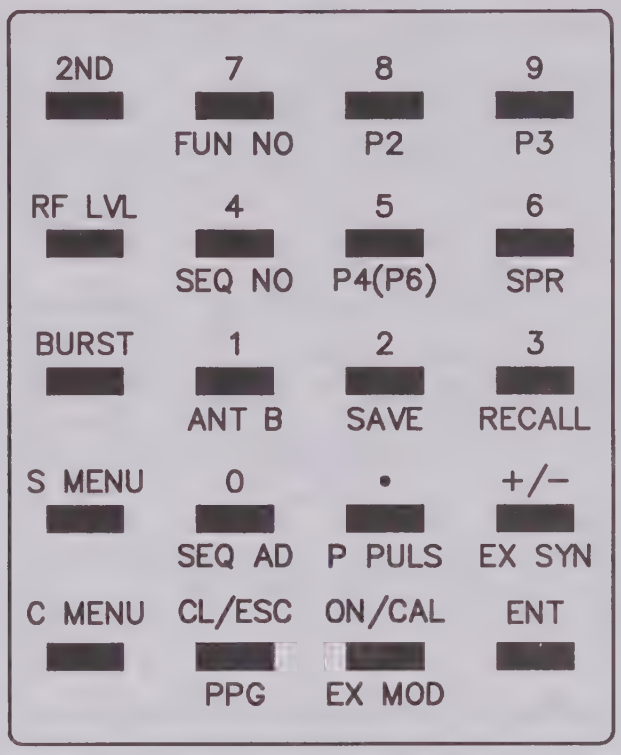
JJ. AUXILIARY Connector (J10010)

25-pin female connector provides timing and pulse signals between the S-1403C and ATC-1400A through AUXILIARY Connector (72). Refer to Appendix A for pin-outs.

KK. 80 MHz Adjust (L11006)

Used only during calibration or maintenance to set edge detect oscillator.

B. Keyboard Definition (Refer to 1-2-2, Figure 7.)



S-1403C Keyboard
Figure 7

The S-1403C Keyboard (B) consists of 20 keys (24 keys mechanically including the CURSOR Keys [A]). The keys allow data entry for selecting test functions, menu formats and field data. Most keys have dual functions. First order functions (shown above each key) are activated by simply pressing the desired key. Second order functions (shown below the key) are activated by pressing the 2ND Key, then the desired second order key. CURSOR Keys (A) are located adjacent to the Keyboard (B) to expedite entering data. Keys are listed below as first order functions with second order functions being the alternative:

2ND Key

The 2ND Key is used to select second order functions. Second order functions are labeled in blue below the respective keys. To activate any second order function, press 2ND Key before selecting the second order function key.

7 or FUN NO Key

The "7" Key is used to enter the number 7 in data fields.

Pressing 2ND, FUN NO and test function number (1 to 7) Keys in sequence displays the corresponding test function menu. Refer to 1-2-2, Table 3 for Test Function Selections.

TEST FUNCTION NUMBER	CONTROL MENU #1 DISPLAY	FUNCTION
1	***Func: (1) ATC***	ATCRBS Only
2	***Func: (2) SEQ***	Mode S Only
3	***Func: (3) ACS***	ATCRBS Only All-Call
4	***Func: (4) ACL***	ATCRBS/Mode S All-Call
5	***Func: (5) INTLCE, Ratio 1:(1 to 999)***	Interlace Ratio of Mode S to ATCRBS
6	***Func: (6) DI, 1st= ___,2nd= ___***	Double Interrogation ATC, ACS, ACL or SEQ for either or both interrogations
7	***Func: (7) BURST, ___,(1 to 999)***	ATC, ACS, ACL or SEQ Functions for 1 to 999 interrogations

Test Function Selections
Table 3

8 or P2 Key

The "8" Key is used to enter the number 8 in data fields.

Pressing 2ND and P2 Keys in sequence moves cursor to the ***P2:*** field for edit in Control Menu #1. The P2 Key function operates from any menu and causes Control Menu #1 to be displayed, but only if the ***P2:*** field applies to the current test function.

9 or P3 Key

The "9" Key is used to enter the number 9 in data fields.

Pressing 2ND and P3 Keys in sequence moves cursor to the ***P3:*** field for edit in Control Menu #1. The P3 Key function operates from any menu and causes Control Menu #1 to be displayed, but only if the ***P3:*** field applies to the current test function.

RF LVL Key

Pressing the RF LVL Key moves cursor to the ***RFLvl:*** field for edit in Control Menu #1. The RF LVL (RF Signal Level) Key function operates from any menu and causes Control Menu #1 to be displayed.

4 or SEQ NO Key

The "4" Key is used to enter the number 4 in data fields.

Pressing 2ND, SEQ NO, sequence number (1 to 16) and ENT Keys in sequence displays the current corresponding sequence menu.

5 or P4(P6) Key

The "5" Key is used to enter the number 5 in data fields.

Pressing 2ND and P4(P6) Keys in sequence moves cursor to the ***P4:*** field or ***P6:*** field for edit in Control Menu #1. The P4(P6) Key function operates from any menu and causes Control Menu #1 to be displayed, but only if the ***P4:*** or ***P6:*** field applies to the current test function.

6 or SPR Key

The "6" Key is used to enter the number 6 in data fields.

Pressing 2ND and SPR Keys in sequence moves cursor to the ***SPR:*** field for edit in Control Menu #1. The SPR (Synchronous Phase Reversal) Key function operates from any menu and causes Control Menu #1 to be displayed, but only if the ***SPR:*** field applies to the current test function.

BURST Key

The BURST Key activates the BURST Test Function. When the BURST Test Function is activated, the number of interrogations specified in Control Menu #1 FUNC: field are transmitted at a PRF programmed by the ATC-1400A PRF/SQTR Thumbwheels (41).

NOTE: The BURST Key function is only active when the BURST Test Function is operating.

1 or ANT B Key

The "1" Key is used to enter the number 1 in data fields, selecting memory location number 1 and selecting Control Menu #1.

Pressing 2ND and ANT B Keys in sequence moves cursor to the ***AntB:*** field for edit in Control Menu #1. The ANT B (Antenna B) Key function operates from any menu and causes Control Menu #1 to be displayed.

2 or SAVE Key

The "2" Key is used to enter the number 2 in data fields, selecting memory location number 2 and selecting Control Menu #2.

Pressing 2ND, SAVE and memory location number (1 or 2) Keys in sequence saves all menus (control and sequence menus). After editing from one to all seven test functions, the SAVE Key function is used to save all current information in one of two non-volatile memory locations. Previous information in the corresponding memory location is overwritten.

3 or RECALL Key

The "3" Key is used to enter the number 3 in data fields.

Pressing 2ND, RECALL and memory location number (1 or 2) Keys in sequence recalls all the menu information saved in the corresponding memory location. All functions are executed to assure system operation is updated with the new menus. Control Menu #1 of the test function that was operating when saved, is displayed. If not saved, menu settings at the time of the recall action are lost.

S MENU Key

Pressing the S MENU Key displays the sequence menu last displayed. Sequence Menu S01 is the default menu on power-up.

0 or SEQ AD Key

The "0" Key is used to enter the number 0 in data fields.

Pressing 2ND and SEQ AD Keys in sequence moves cursor to the ***ADD=*** field (uplink format address) for edit in the sequence menu. The SEQ AD (Sequential Address) Key function operates from any menu and causes the last displayed sequence menu or Sequence Menu S01 (default) to be displayed.

• or P PULS Key

The • Key is used to enter the decimal point in data fields.

Pressing 2ND and P PULS Keys in sequence moves cursor to the ***Prepulse:*** field for edit in Control Menu #2. The P PULS (Prepulse) Key function operates from any menu and causes Control Menu #2 to be displayed.

+/- or EXT SYN Key

Pressing the +/- Key displays the plus (+) or minus (-) sign before decimal data. The +/- Key function changes decimal value from positive (+) to negative (-) or vice versa and automatically enters the new value without pressing the ENT Key. The +/- Key function is used after editing the decimal data field.

Pressing 2ND and EXT SYN Keys in sequence moves cursor to the ***Ext. Sync.:Out=*** field for edit in Control Menu #2. The EXT SYN (External Sync output) Key function operates from any menu and causes Control Menu #2 to be displayed.

C MENU Key

Pressing C MENU and menu number (1 or 2) Keys in sequence displays the corresponding control menu.

CL/ESC or PPG Key

Pressing the CL/ESC Key in the middle of an edit (before pressing ENT Key) clears input data and restores previous data. For octal data fields, the CL/ESC Key function resets the entire field to zero.

Pressing 2ND and PPG Keys in sequence moves cursor to the ***Pulse Power Gate:*** field for edit in Control Menu #2. The PPG (Pulse Power Gate) Key function operates from any menu and causes Control Menu #2 to be displayed.

ON/CAL or EX MOD Key

The ON/CAL Key sets control or command fields to a particular mode (***ON*** or ***OFF***, ***CAL*** or ***VAR*** or ***OFF***, ***OFF*** or variable value, ***CAL*** or variable value) depending on the control field.

Pressing 2ND and EX MOD Keys in sequence moves cursor to the ***Ext.Mod.In:*** field for edit in Control Menu #2. The EX MOD (External Modulation input) Key function operates from any menu and causes Control Menu #2 to be displayed.

ENT Key

The ENT Key is used for data entry. The ENT Key is pressed after editing a data field using the Keyboard (B).

C. Display Menu Definition

Three basic menus are shown on the MENU Display (I). Control Menu #1 modifies characteristics of interrogation pulses and shows reply results. Control Menu #2 sets external inputs and outputs while providing power measurement control. Sequence menus load Mode S interrogation information and display reply content. Control fields contain statements controlling testing parameters and data fields contain numbers representing values or information. Fields not used (inactive) in particular functions are blank. Fields used, but not currently being updated or out of range, display dashes.

Errors cause a flashing error message to overwrite the top line of the MENU Display (I) in all menus. When an error occurs, one of the following error messages is displayed:

- **** AP ERROR ****

  Indicates an Address Parity field error or the transponder is replying with an address different than the one in the interrogation. The AP ERROR message is displayed until the next downlink with a valid Address Parity field is received.

- **** DME MODE ****

  Occurs when the FREQ/FUNCTION SELECT Thumbwheels (45) are set to DME function instead of XPDR (transponder) function. The XPDR function is the required setting for Mode S Test System operation.

- **** RECALL ERROR ****

  Occurs when the RECALL Key function is performed for a memory location buffer with no information previously saved. RECALL ERROR could also signify backup battery problems. The RECALL ERROR message is displayed until another key is pressed on the front panel.

- **** DI/INTF ERROR ****

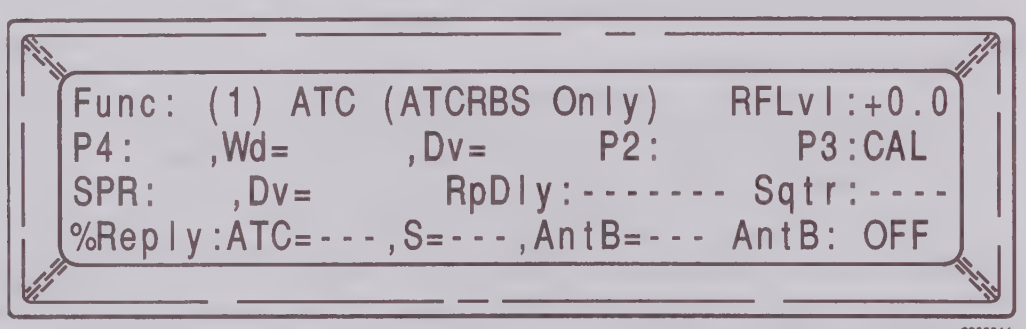
  Occurs when one test set of the Mode S Test System (S-1403C or ATC-1400A) is set for Double Interrogations while the other test set is not. DBL INTERR/INTRF PULSE Thumbwheels (42) selections are monitored by the S-1403C. The DOUBLE position is valid only when the S-1403C is operating in the DI Test Function.

- **** PRF LIMITED ****

  Occurs when the PRF set by ATC-1400A PRF/SQTR Thumbwheels (41) is larger than the PRF limitations defined in 1-3-1.

(1) Control Menu #1

(a) ATC Test Function (Refer to 1-2-2, Figure 8.)



ATC Test Function Control Menu #1
Figure 8

***Func:* Field**

The ATC Test Function is displayed according to 1-2-2, Table 3.

***RFLvl:* Field**

The ***RFLvl:*** field provides RF Level vernier control in addition to the RF LEVEL Control (6). The ***RFLvl:*** field setting combines with the RF LEVEL -dBm Display (3) indication to reflect the Mode S Test System RF Level output through the RF I/O Connector (9). The ***RFLvl:*** field is set between -3.0 and +3.0 dB in 0.1 dB steps.

***P3:* Field**

Controls level of P_3 pulse.

P3:CAL sets P_3 pulse level at 0.0 dB in relationship to P_1.

P3:VAR allows the SLS/ECHO Thumbwheels (50) to adjust P_3 pulse level (only when SLS/ECHO ON/OFF Switch [18] is OFF).

P3:OFF deactivates P_3 pulse.

***RpDly:* Field**

Displays reply delay (P_3 leading edge to F_1 leading edge) in microseconds. The field has a specified range from 2.000 to 4.000 µs with 25 ns resolution and 100 ns accuracy.

***Sqtr:* Field**

Displays time interval between Mode S squitter transmissions. The field ranges from 0.00 to 9.99 seconds with 0.01 seconds resolution.

NOTE: Mode S squitters are unsolicited Downlink Format (DF) 11 transmissions.

***%Reply:* Field**

Displays the percentage of replies received to interrogations transmitted.

NOTE: For all test functions, refer to the S-1403C Control Menu #1 ***%Reply:*** field for valid percent reply information. The DME-PRF Hz/XPDR-%REPLY Display (46) is invalid because Mode S squitter transmissions are included.

The ***%Reply:*** field includes the following subfields:

- ***ATC=* Subfield**

  Displays the percentage of ATCRBS replies received to interrogations transmitted through the RF I/O Connector (9). Range is 0 to 999 with ±1 step accuracy.

- ***S=* Subfield**

  Displays the percentage of Mode S replies received to interrogations transmitted through the RF I/O Connector (9). Range is 0 to 999 with ±1 step accuracy.

- ***AntB=* Subfield**

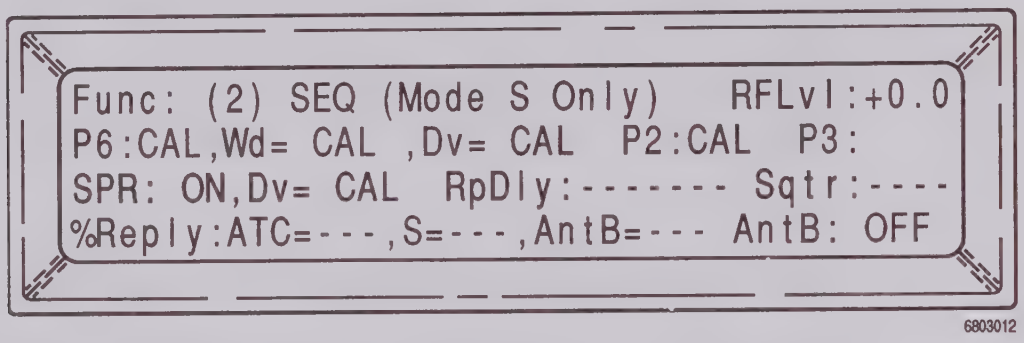
  Displays the percentage of replies received to interrogations transmitted through ANT B Connector (E). Range is 0 to 999 with ±1 step accuracy.

***AntB:* Field**

Activates ANT B Connector (E) and sets the diversity offset value (timing difference from Antenna A transmissions to Antenna B transmissions [P_1 leading edge to P_1 leading edge]). Offset range is -0.95 to +0.95 µs in 0.05 µs steps.

AntB: OFF disables ANT B Connector (E).

(b) Sequence Test Function (Refer to 1-2-2, Figure 9.)



Sequence Test Function Control Menu #1
Figure 9

***Func:* Field**

The SEQ Test Function is displayed according to 1-2-2, Table 3.

***RFLvl:* Field**

Same as ***RFLvl:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

***P6:* Field**

Controls P_6 pulse operation in Mode S interrogations.

P6:CAL activates P_6 pulse.

P6:OFF deactivates P_6 pulse.

The two following subfields also control P_6 pulse characteristics:

- ***Wd=* Subfield**

  Controls width of P_6.

  P6:,Wd= CAL sets P_6 width at 16.25 µs for 56-bit data fields and 30.25 µs for 112-bit data fields.

  P6:,Wd= (variable value) adjusts P_6 width ±1.50 µs from CAL width in 0.05 µs steps.

- ***Dv=* Subfield**

  Controls position of P_6.

  P6:,Dv= CAL sets P_6 position at 3.5 µs following leading edge of P_1.

  P6:,Dv= (variable value) deviates P_6 ±1.95 µs from CAL position in 0.05 µs steps.

***P2:* Field**

Controls level of P_2 pulse.

P2:CAL sets P_2 pulse level at 0.0 dB in relationship to P_1.

P2:VAR allows SLS/ECHO Thumbwheels (50) to adjust P_2 pulse level (only when SLS/ECHO ON/OFF Switch [18] is OFF).

P2:OFF deactivates P_2 pulse.

***SPR:* Field**

Controls Synchronous Phase Reversal (SPR) in Mode S interrogations.

SPR: ON activates SPR.

SPR: OFF deactivates SPR.

SPR: field includes the following subfield:

- ***Dv=* Subfield**

  Controls position of SPR.

  SPR:,Dv= CAL sets SPR at 1.25 µs following P_6 leading edge.

  SPR:,Dv= (variable value) deviates SPR ±1.00 µs from CAL position in 0.05 µs steps.

***RpDly:* Field**

Displays reply delay (SPR to P_1 leading edge of reply). The field has a specified range from 126.000 to 130.000 µs with 25 ns resolution and 50 ns accuracy.

***Sqtr:* Field**

Same as ***Sqtr:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

NOTE: Only unsolicited DF11 transmissions >140 µs following SPR are accepted as Mode S squitters.

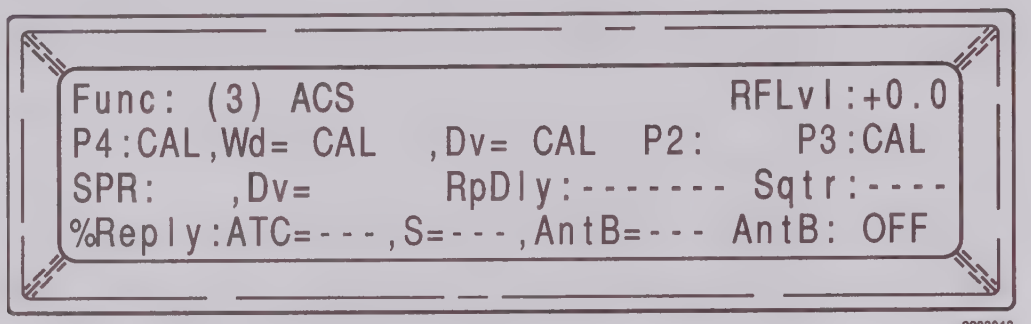
***%Reply:* Field**

Same as ***%Reply:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

***AntB:* Field**

Same as ***AntB:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

(c) ACS Test Function (Refer to 1-2-2, Figure 10.)



ACS Test Function Control Menu #1
Figure 10

***Func:* Field**

The ACS (All-Call Short) Test Function is displayed according to 1-2-2, Table 3.

***RFLvl:* Field**

Same as ***RFLvl:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

***P4:* Field**

Controls level of P_4 pulse.

P4:CAL sets P_4 pulse level at 0.0 dB in relationship to P_1.

P4:VAR allows SLS/ECHO Thumbwheels (50) to adjust P_4 pulse level (only when SLS/ECHO ON/OFF Switch [18] is OFF).

P4:OFF deactivates P_4 pulse.

The two following subfields also control P_4 pulse characteristics:

- ***Wd=* Subfield**

  Controls width of P_4.

  P4:,Wd= CAL sets P_4 width at 0.8 µs.

  P4:,Wd= (variable value) adjusts P_4 width from -0.60 to +1.95 µs from CAL in 0.05 µs steps.

  NOTE: Because of variable P_4 width control, ACS may function as ACL.

- ***Dv=* Subfield**

  Controls position of P_4 relative to P_1, leading edge to leading edge.

  P4:,Dv= CAL sets P_4 position at 2.0 µs following P_3, leading edge to leading edge.

  P4:,Dv= (variable value) deviates P_4 ±1.95 µs from CAL position in 0.05 µs steps.

***P3:* Field**

Same as ***P3:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

***RpDly:* Field**

Displays reply delay (P_3 leading edge to F_1 leading edge of ATCRBS replies or P_4 leading edge to P_1 leading edge of Mode S replies).

Sqtr: Field

Same as ***Sqtr:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

NOTE: Only unsolicited DF11 transmissions >141.8 µs after trailing edge of P_4 are accepted as Mode S squitters. If P_4 is deactivated, any unsolicited DF11 transmissions are accepted as Mode S squitters.

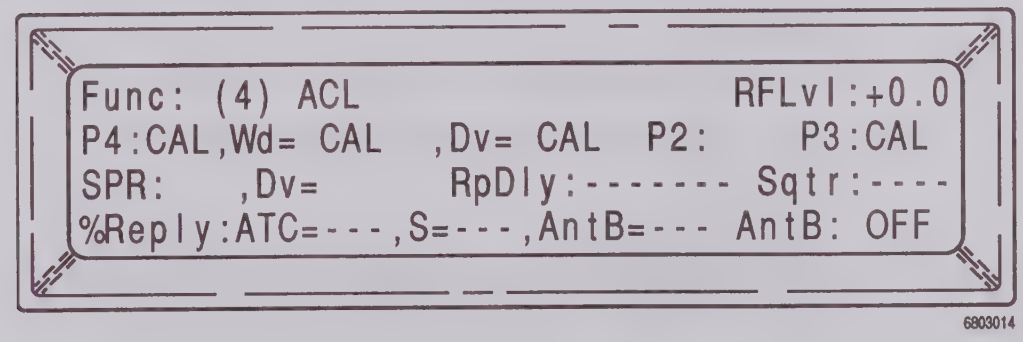
***%Reply:* Field**

Same as ***%Reply:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

***AntB:* Field**

Same as ***AntB:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

(d) ACL Test Function (Refer to 1-2-2, Figure 11.)



ACL Test Function Control Menu #1
Figure 11

***Func:* Field**

The ACL (All-Call Long) Test Function is displayed according to 1-2-2, Table 3.

***RFLvl:* Field**

Same as ***RFLvl:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

***P4:* Field**

Level and position fields are the same as in ACS Test Function. Refer to 1-2-2C(1)(c). The ***P4:,Wd=*** subfield has the following differences:

- ***P4:,Wd= CAL*** sets P_4 width at 1.6 µs.
- ***P4:,Wd=*** (variable value) adjusts P_4 width from -1.40 to +1.95 µs from CAL in 0.05 µs steps.

  NOTE: Because of variable P_4 width control, ACL may function as ACS.

***P3:* Field**

Same as ***P3:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

***RpDly:* Field**

Same as ***RpDly:*** field in ACS Test Function. Refer to 1-2-2C(1)(c).

***Sqtr:* Field**

Same as ***Sqtr:*** field in ACS Test Function. Refer to 1-2-2C(1)(c).

***%Reply:* Field**

Same as ***%Reply:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

***AntB:* Field**

Same as ***AntB:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

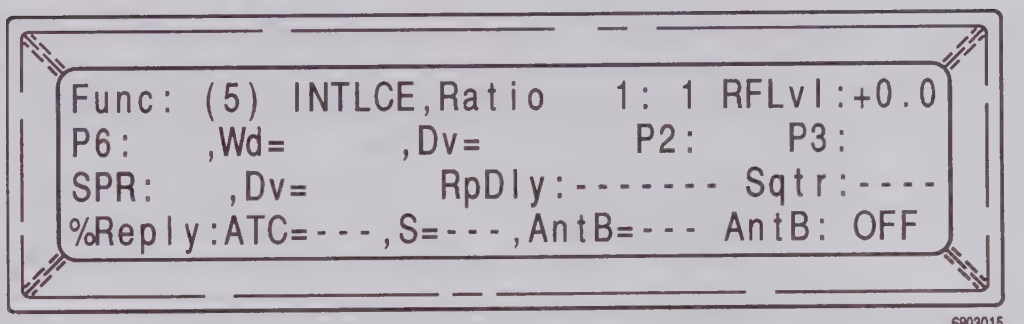
(e) INTLCE Test Function (Refer to 1-2-2, Figure 12.)

***Func:* Field**

The INTLCE (Interlace) Test Function is displayed according to 1-2-2, Table 3. The ***Func:*** field contains the following subfield:

- ***Ratio 1:* Subfield**

  Sets number of ATCRBS interrogations (1 to 999) transmitted for each Mode S interrogation transmitted.



INTLCE Test Function Control Menu #1
Figure 12

***RFLvl:* Field**

Same as ***RFLvl:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

***RpDly:* Field**

Displays reply delay for ATCRBS only and operates the same as in ATC Test Function.

***Sqtr:* Field**

Same as ***Sqtr:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

NOTE: Only unsolicited DF11 transmissions following ATCRBS interrogations or >140 µs following SPR of Mode S interrogations are accepted as Mode S squitters.

***%Reply:* Field**

Same as ***%Reply:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

***AntB:* Field**

Same as ***AntB:*** field in ATC Test Function. Refer to 1-2-2C(1)(a).

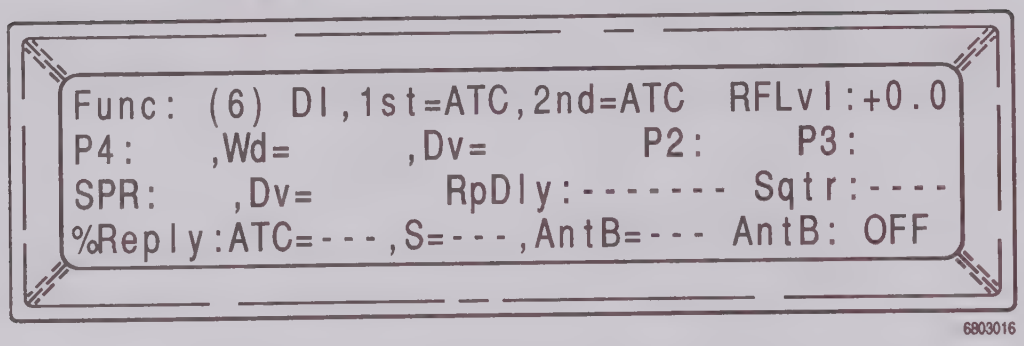
(f) DI Test Function (Refer to 1-2-2, Figure 13.)

***Func:* Field**

The DI (Double Interrogation) Test Function is displayed according to 1-2-2, Table 3. The ***Func:*** field contains the following subfields:

- ***1st=* Subfield**

  Sets test function mode (ATC, SEQ, ACS or ACL) for the first interrogation sent as part of the DI (Double Interrogation) Test Function. The test function mode for the first interrogation determines what control and data fields operate in the DI Test Function.



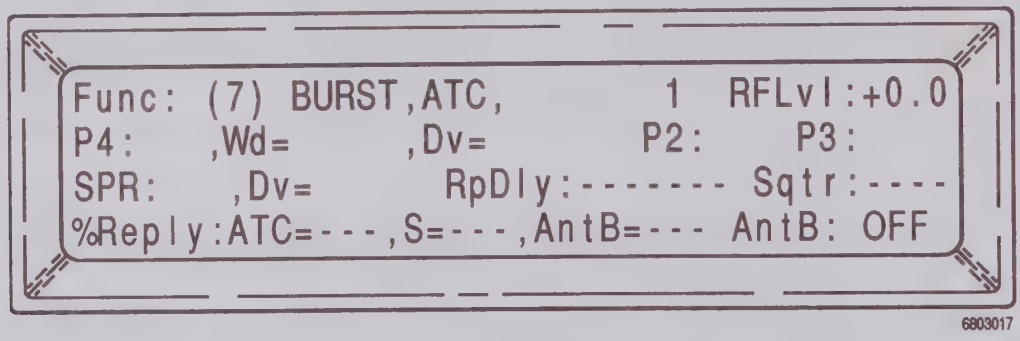
DI Test Function Control Menu #1
Figure 13

- ***2nd=* Subfield**

  Sets test function mode (ATC, SEQ, ACS or ACL) for the second interrogation sent as part of the DI (Double Interrogation) Test Function.

Other fields depend on test function mode selected for first interrogation. All fields except for ***P3:*** operate the same as in the particular test function selected.

(g) BURST Test Function (Refer to 1-2-2, Figure 14.)



BURST Test Function Control Menu #1
Figure14

***Func:* Field**

The BURST Test Function is displayed according to 1-2-2, Table 3. The ***Func:*** field contains the following subfields:

- **Test Function Mode Subfield**

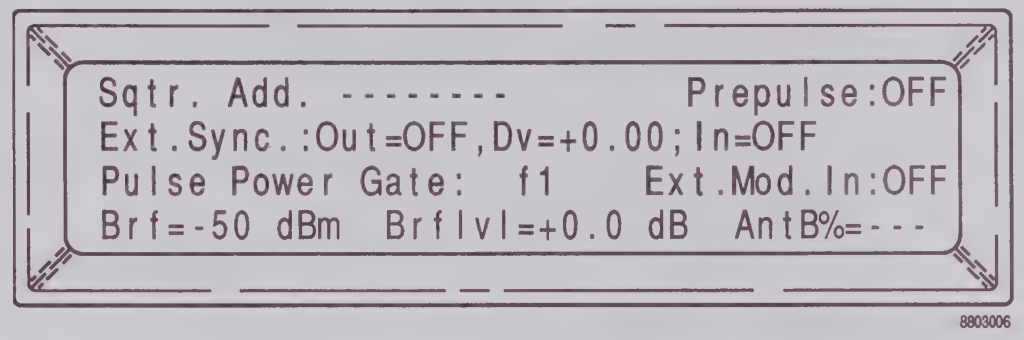
  Sets operating test function mode (ATC, SEQ, ACS or ACL) for the BURST Test Function.

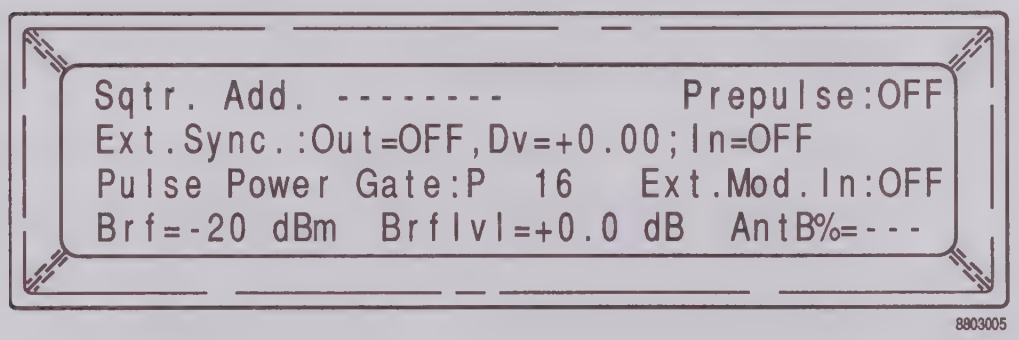
- **BURST Number Subfield**

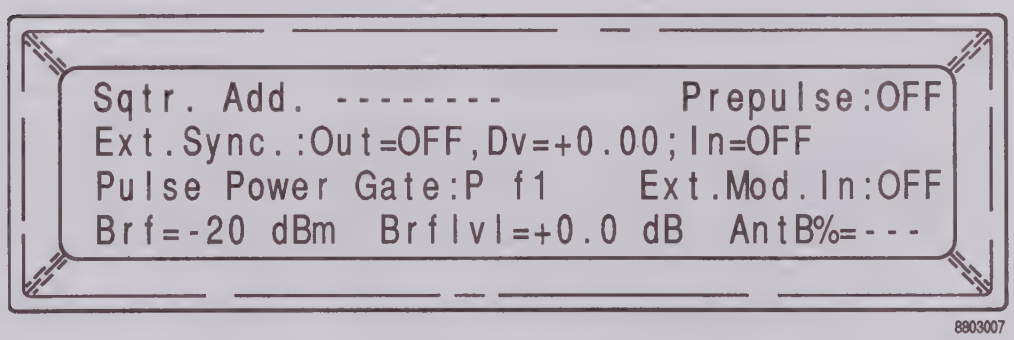
  The BURST Number (BN) is the number of interrogations (1 to 999) transmitted in one BURST Test Function activation.

Other fields depend on test function mode selected. All fields except for ***P3:*** operate the same as in the particular test function selected.

(2) Control Menu #2 (Refer to 1-2-2 Figure 15.)







Control Menu #2
Figure 15

***Sqtr. Add.* Field**

Displays in octal form, the 24-bit UUT address received in Mode S squitters.

***Prepulse:* Field**

Activates PREPULSE OUT Connector (EE).

Prepulse:(variable value) adjusts prepulse position from 0 to 260 µs in 1 µs increments prior to leading edge of P_1 in the interrogation.

Prepulse:OFF deactivates PREPULSE OUT Connector (EE).

***Ext. Sync.:* Field**

Controls external synchronous pulses and includes the following subfields:

- ***Out=* Subfield**

  Ext. Sync.:Out= ON activates EXT SYNC OUT Connector (CC) with an external sync pulse output.

  Ext. Sync.:Out=OFF disables EXT SYNC OUT Connector (CC).

- ***Dv=+0.00* Subfield**

  Sets position of external sync pulse output when ***Ext. Sync.:Out= ON***. Position is set from -9.95 to +9.95 in 0.05 µs increments from the leading edge of P_1 of the interrogation.

- ***In=* Subfield**

  Ext. Sync.:,In= ON activates EXT SYNC IN Connector (BB) for an external sync pulse input. P_1 of interrogation occurs 7.0 µs later. ***Ext. Sync.:Out=*** and ***Dv=*** subfields go blank (external sync out not used).

  Ext. Sync.:,In=OFF disables EXT SYNC IN Connector (BB).

***Pulse Power Gate:* Field**

Selects the reply pulse for which power and frequency measurements are taken. Refer to 1-2-2, Table 4. Reply delay determines where to measure selected pulse. For all reply pulses, Pulse Power Measurement Gate (PPMG) is enabled prior to rising edge of the pulse to be measured. Measurement continues until next falling edge of the reply. Pulse Power Measurement is performed by the ATC-1400A and shown on XMTR PWR WATTS Display (1).

NOTE: For the S-1403C to control pulse power measurement, the F_2/P_2 F_1/P_1 Switch (34) is set to F_2/P_2 position.

KEYBOARD or SLEW ENTRY	ATC PULSE	MODE S PULSE	KEYBOARD or SLEW ENTRY	ATC PULSE	MODE S PULSE
1	f1	P1	10	d1	P10
2	c1	P2	11	b2	P11
3	a1	P3	12	d2	P12
4	c2	P4	13	b4	P13
5	a2	P5	14	d4	P14
6	c4	P6	15	f2	P15
7	a4	P7	16	spi	P16
8	x	P8	17	NA	P17
9	b1	P9	18-116	NA	P18-P116

Pulse Power Gate Mnemonics
Table 4

***Ext.Mod.In:* Field**

Ext.Mod.In: ON deactivates internal modulation for RF I/O Connector (9). Only external modulation through EXT MOD IN Connector (Z) is accepted.

NOTE: When Control Menu #2 is set with ***Ext.Mod.In: ON***, percent reply for Antenna B is disabled.

Ext.Mod.In:OFF allows internal and external (if applied) modulation.

***Brf=* Field** (only with Multi-Level Diversity option installed)

Sets attenuation for ANT B Connector (E) and displays the signal level transmitted through ANT B Connector (E). Signal level is set from -80 to -20 dBm (-50 dBm is default value). This field is displayed only when the Multi-Level Diversity option is installed.

***BrfIvl=* Field** (only with Multi-Level Diversity option installed)

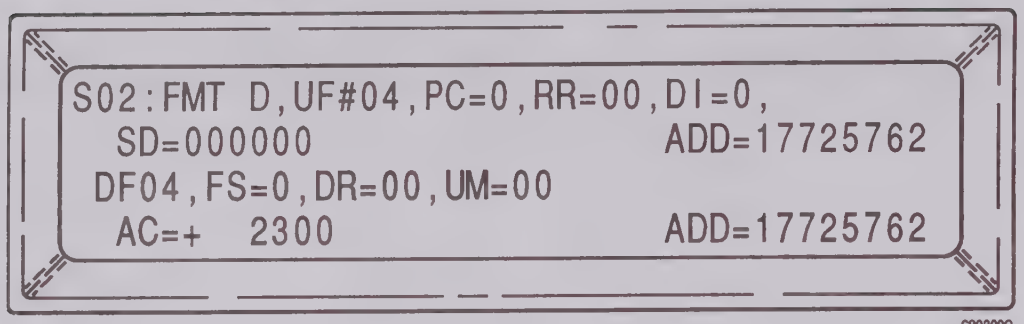
Provides RF Level vernier control of the signal through ANT B Connector (E) in addition to the ***Brf=*** field. The ***BrfIvl:*** field value combines with the ***Brf=*** field setting to provide the total RF Level output through ANT B Connector (E). The ***BrfIvl=*** field is set between -3.0 and +3.0 dB in 0.1 dB steps. This field is displayed only when the Multi-Level Diversity option is installed.

***AntB%=* Field** (only with Multi-Level Diversity option installed)

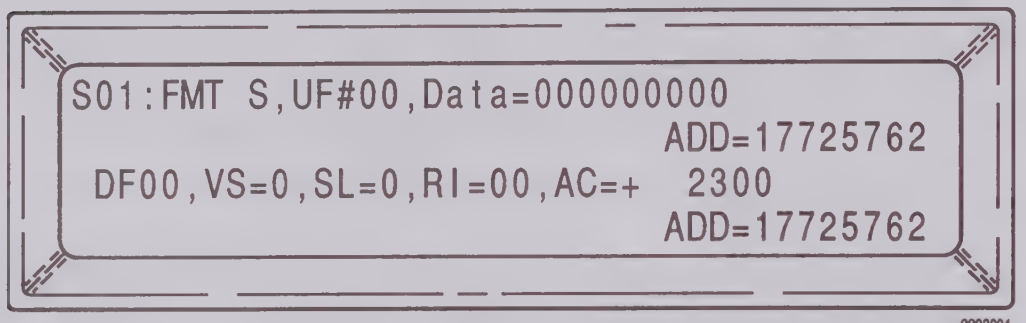
Same as Control Menu #1 ***%Reply:,AntB=*** subfield.

(3) Sequence Menus (Refer to 1-2-2, Figure 16.)

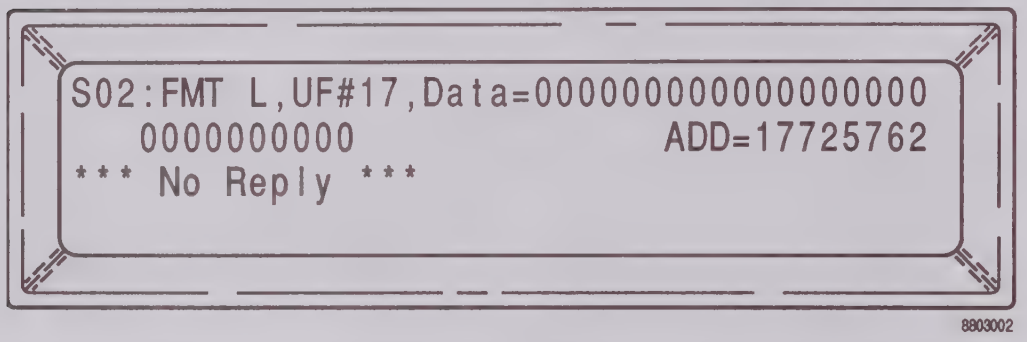
Sequence menus are only used when transmitting Mode S interrogations. Sequence menus program various Mode S interrogations and look at the content of the Mode S replies. Each activated sequence menu is transmitted as one Mode S interrogation. Interrogations are transmitted in numerical order according to sequence number and repeated for all active sequence menus during any test function involving Mode S interrogations.



6803002



8803001



8803002

Sequence Menu
Figure 16

***S*(sequence number)*:* Field**

Activates or deactivates each sequence menu. The sequence number (1 to 16) represents each available sequence menu.

S*(sequence number)*:OFF deactivates that particular menu.

S*(sequence number)*:FMT activates that particular menu.

Default condition on power up has currently defined (RTCA DO-181; March, 1983) uplink and downlink formats assigned to Sequence Menus S01 through S07. Refer to Appendix B for definition of default sequence menus. Sequence menus are activated or deactivated by positioning the cursor under the ***S*(sequence number)*:*** field and pressing the ON/CAL Key.

***FMT* Field**

Selects one of three available format types. Selection is made with SLEW Control (F) or ON/CAL Key.

FMT D sets the format type to defined. Defined allows selection of any one of the seven defined sequence menus shown in Appendix B.

FMT S sets the format type to unspecified short. Unspecified short provides user definable octal data fields for short messages (27-bit, binary message field; 56-bit, binary total Mode S data).

FMT L sets the format type to unspecified long. Unspecified long provides user definable octal data fields for long messages (83-bit, binary message field; 112-bit, binary total Mode S data).

***UF#* Field**

Selects Uplink Format (UF) number with SLEW Control (F) or Keyboard (B) entry. UF00 through UF31 are selectable unspecified short or long formats. UF00, UF04, UF05, UF11, UF16, UF20 or UF21 are selectable defined formats. Signal Formats are defined in Appendix E.

Mode S Interrogation Data Fields

Mode S interrogation data fields are setup to contain information as defined in Appendix E. Unspecified short formats display one programmable ***Data=*** field with nine octal data positions (27-bit, binary). Unspecified long formats display one programmable ***Data=*** field with 28 octal data positions (83-bit, binary). Defined formats contain programmable specified fields as shown in Appendix B and defined in Appendix E. ***ADD=*** field (transponder address in octal form) data is converted to the required address and parity (AP) field data before transmission.

NOTE: Any undesignated bits in the data fields are set to zero.

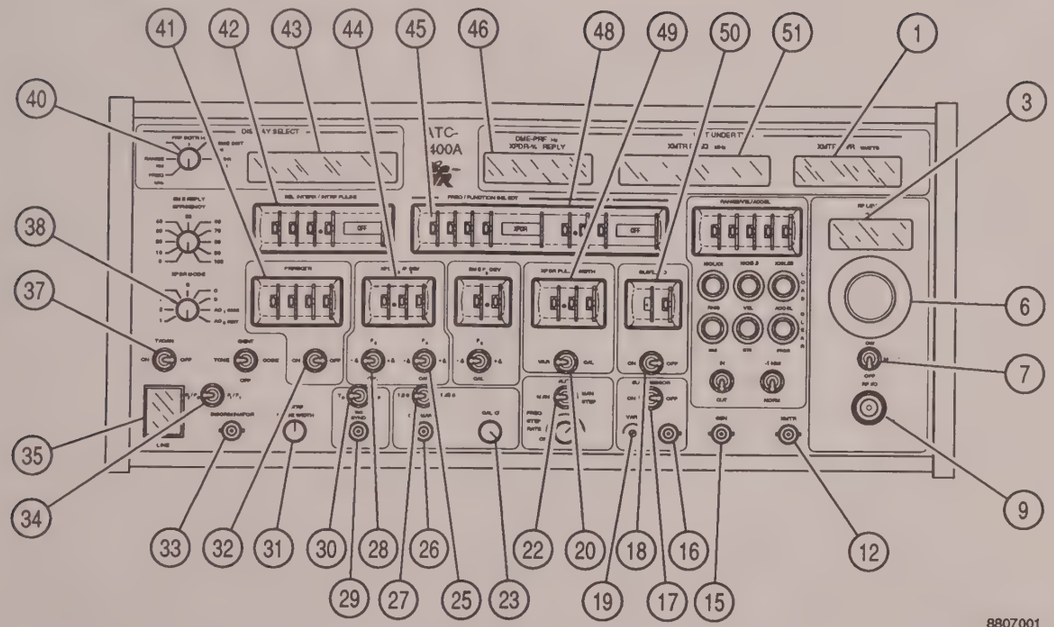
Mode S Reply Data Fields

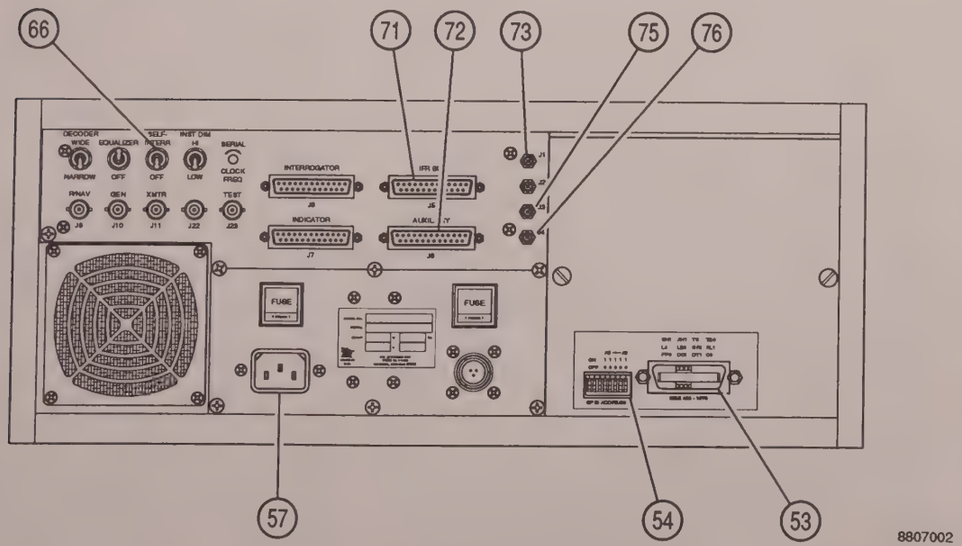
Downlink Formats (DF) (***00*** through ***31***) are read only fields displaying downlink information received from the transponder. Default downlink formats are shown in Appendix B and defined in Appendix E. The downlink ***ADD=*** field is the AP field with parity information stripped and transponder address converted to octal. ****** No Reply ****** is displayed when no reply is received.

D. ATC-1400A Front and Rear Panels (Refer to 1-2-2, Figure 17.)

The following ATC-1400A controls, connectors and indicators are utilized with the Mode S Test System. Some controls, connectors and indicators listed are not directly involved with testing Mode S transponders, but are critical to operation if not set correctly. Descriptions listed in 1-2-2D supersede descriptions listed in the ATC-1400A Operation Manual.

D. ATC-1400A Front and Rear Panels





1. XMTR PWR WATTS Display
3. RF LEVEL -dBm Display
6. RF LEVEL Control
7. CW/NORM/OFF Switch
9. RF I/O Connector (J1015)
12. XMTR Connector (J1016)
15. GEN Connector (J1017)
16. SUPPRESSOR OUTPUT Connector (J1018)
17. SUPPRESSOR ON/OFF Switch
18. SLS/ECHO ON/OFF Switch
19. SUPPRESSOR VAR Adjustment
20. XPDR PULSE WIDTH VAR/CAL Switch
22. MAN/AUTO/MAN STEP Switch
23. CAL Ø Control
25. XPDR DEV P_3/CAL Switch
26. CAL MARKS Connector (J1019)
27. 1.0 µS/1.45 µS Switch
28. XPDR DEV P_2/CAL Switch
29. SYNC Connector (J1020)
30. T_O/TAC/T_D Switch
31. INTRF PULSE WIDTH Control
32. PRF/SQTR ON/OFF Switch
33. DISCRIMINATOR Connector (J1021)
34. F_2/P_2 F_1/P_1 Switch
35. LINE Switch
37. TACAN ON/OFF Switch
38. XPDR MODE Control
40. DISPLAY SELECT Control
41. PRF/SQTR Thumbwheels
42. DBL INTERR/INTRF PULSE Thumbwheels
43. DISPLAY SELECT Readout
44. XPDR P_2/P_3 DEV Thumbwheels
45. FREQ/FUNCTION SELECT Thumbwheels
46. DME-PRF Hz/XPDR-%REPLY Display
48. ΔF Thumbwheels
49. XPDR PULSE WIDTH Thumbwheels
50. SLS/ECHO Thumbwheels
51. XMTR FREQ MHz Display
53. GPIB Connector
54. GPIB ADDRESS/OPTION Dip Switches
57. AC INPUT Connector
66. SELF-INTERR/OFF Switch
71. IFR BUS Connector (J9105)
72. AUXILIARY Connector (J9102)
73. DABS INPUT Connector (J9101)
75. EXTERNAL MEASUREMENT GATE Connector (J9103)
76. RF LEVEL INPUT Connector (J9104)

ATC-1400A Front and Rear Panels
Figure 17

ITEM DESCRIPTION

1. XMTR PWR WATTS Display

   Continuously displays the peak pulse power of the UUT reply pulse selected in the ***Pulse Power Gate:*** field of the S-1403C Control Menu #2.

3. RF LEVEL -dBm Display

   Displays the programmed peak RF power of the ATC-1400A generator in dB below 1 mW.

6. RF LEVEL Control

   Adjusts ATC-1400A RF generator level in 1 dB steps by slowly turning control knob.

7. CW/NORM/OFF Switch

   Controls the signal through the RF I/O Connector (9).

   CW supplies continuous wave signal (RF signal with no modulation) at the frequency selected by FREQ/FUNCTION SELECT Thumbwheels (45) and ΔF Thumbwheels (48). CW setting is used to test the Mode S Test System.

   NORM allows the Mode S Test System to transmit interrogations (modulated RF signal). NORM is the normal setting for Mode S Test System operation.

   OFF disables output.

9. RF I/O Connector (J1015)

   "N" type connector for all interrogation and reply signals to and from the UUT primary antenna (Antenna A [ANT A]) connector.

12. XMTR Connector (J1016)

    BNC type connector provides detected UUT reply pulses for viewing on an oscilloscope.

15. GEN Connector (J1017)

    BNC type connector provides detected interrogation and interference pulses for viewing on oscilloscope.

16. SUPPRESSOR OUTPUT Connector (J1018)

    BNC type connector provides mutual suppression pulses.

ITEM DESCRIPTION

17. SUPPRESSOR ON/OFF Switch

Enables or disables mutual suppression pulses.

NOTE: When suppressor pulse is activated and DOUBLE is selected on DBL INTERR/INTRF PULSE Thumbwheels (42), the first interrogation of a double interrogation is omitted. DBL INTERR/INTRF PULSE Thumbwheels (42) determine delay from suppression pulse to second interrogation.

18. SLS/ECHO ON/OFF Switch

Enables or disables Side-Lobe Suppression (SLS) pulses.

ON adds the P_2 (ATCRBS) or P_5 (Mode S) SLS pulse to the interrogation transmission. The SLS/ECHO Thumbwheels (50) control only the amplitude of the SLS pulse when activated.

NOTE: Interrogation and SLS pulses are inhibited when DBL INTERR/INTRF PULSE Thumbwheels (42) are set to INTERF+ or INTERF-.

OFF disables SLS and allows the SLS/ECHO Thumbwheels (50) to control other pulse amplitudes if selected.

19. SUPPRESSOR VAR Adjustment

Adjusts voltage level of mutual suppression pulse from +3 to +27 V.

20. XPDR PULSE WIDTH VAR/CAL Switch

VAR selects a variable interrogation pulse width set by the XPDR PULSE WIDTH Thumbwheels (49). Only the widths of P_1, P_2 (if selected) and P_3 (if applicable and selected) are controlled by this switch.

CAL selects an interrogation pulse width of 0.8 µs.

22. MAN/AUTO/MAN STEP Switch

Set to MAN position for Mode S Test System operation.

23. CAL Ø Control

Adjusts the phase of calibration (timing) pulses with respect to interrogation pulses. Rotating control cw delays calibration pulses and enables the operator to align calibration pulses with reply pulses.

ITEM DESCRIPTION

25. XPDR DEV P_3/CAL Switch

-Δ advances position of P_3 pulse from nominal, by value selected on XPDR P_2/P_3 DEV Thumbwheels (44), in microseconds.

CAL sets P_3 pulse to nominal position. Refer to Appendix F. XPDR P_2/P_3 DEV Thumbwheels (44) do not deviate P_3 pulse.

+Δ delays position of P_3 pulse from nominal, by value selected on XPDR P_2/P_3 DEV Thumbwheels (44), in microseconds.

26. CAL MARKS Connector (J1019)

BNC type connector provides an output for the calibration pulses set by the 1.0 µS/1.45 µS Switch (27) and aligned by the CAL Ø Control (23).

27. 1.0 µS/1.45 µS Switch

Selects 1.0 µs calibration pulses for Mode S replies or 1.45 µs calibration pulses for ATCRBS replies. Calibration pulses are transmitted through the CAL MARKS Connector (26).

28. XPDR DEV P_2/CAL Switch

-Δ advances position of the P_2 pulse from nominal, by value selected on the XPDR P_2/P_3 DEV Thumbwheels (44), in microseconds.

CAL sets P_2 pulse (SLS in ATCRBS) to nominal position. XPDR P_2/P_3 DEV Thumbwheels (49) do not deviate P_2 pulse.

+Δ delays position of the P_2 pulse from nominal, by value selected on the XPDR P_2/P_3 DEV Thumbwheels (44), in microseconds.

29. SYNC Connector (J1020)

BNC type connector provides active low oscilloscope sync pulse set by T_O/TAC/T_D Switch (30). Sync pulse is 17.5 µs prior to P_1 of the interrogation for T_O position and coincidental with P_3 of the interrogation for T_D position.

30. T_O/TAC/T_D Switch

Controls sync pulse positions through the SYNC Connector (29) and the SCOPE TRIG OUT Connector (AA).

T_O positions sync pulse for viewing interrogation pulses on oscilloscope.

TAC is not used by the Mode S Test System.

T_D positions sync pulse for viewing reply or second interrogation (DI Test Function) pulses on oscilloscope.

ITEM DESCRIPTION

31. INTRF PULSE WIDTH Control

Adjusts width of interference pulse from 0.2 µs to 5 µs.

32. PRF/SQTR ON/OFF Switch

Enables or disables interrogation transmissions through the RF I/O Connector (9).

33. DISCRIMINATOR Connector (J1021)

BNC type connector provides discriminated RF input pulses used to calculate individual reply pulse frequencies. The discriminator produces noise when no RF is present.

34. F_2/P_2 F_1/P_1 Switch

F_2/P_2 enables PPMG control by the S-1403C in Control Menu #2. The ATC-1400A measures power and frequency for the pulse selected in the ***Pulse Power Gate:*** field.

F_1/P_1 enables ATC-1400A to measure power and frequency of the F_1 or P_1 pulse of the reply. PPMG control by the S-1403C is disabled.

35. LINE Switch

Applies external ac power to the ATC-1400A.

37. TACAN ON/OFF Switch

Set to OFF position for Mode S Test System operation.

38. XPDR MODE Control

Selects interrogation mode by setting nominal P_3 pulse position for ATCRBS and All-Call interrogations. All modes (1, 2, T[Test], A[3], B, C and D) are operational. Modes A and C are the primary modes of ATC Test Function and All-Call Test Function (ACS or ACL) operation.

NOTE: In Mode S Test System operation, AC_1 is the same as A and AC_2 is the same as C. DISPLAY SELECT Readout (43) displays Mode C altitude in feet when DISPLAY SELECT Control (40) is in XPDR CODE position and AC_2 is selected on XPDR MODE Control.

ITEM DESCRIPTION

40. DISPLAY SELECT Control

Sets the DISPLAY SELECT Readout (43). Only three positions are valid in Mode S Test System operation.

FREQ MHz displays interrogation RF relating to settings on FREQ/FUNCTION SELECT Thumbwheels (45) and ΔF Thumbwheels (48).

PRF/SQTR Hz displays the PRF as set by the PRF/SQTR Thumbwheels (41).

XPDR CODE displays the octal form of code received in ATCRBS replies. When XPDR MODE Control (38) is in AC_2 position, Mode C altitude is displayed in feet.

41. PRF/SQTR Thumbwheels

Selects interrogation rate in Hz. For DI Test Function, interrogation rate is twice the thumbwheels value.

42. DBL INTERR/INTRF PULSE Thumbwheels

OFF is normal operating position and regular interrogations are transmitted.

INTERF- transmits an interference pulse with each interrogation. Thumbwheels determine interference pulse position in microseconds prior to leading edge of P_1 of the interrogation.

INTERF+ transmits an interference pulse with each interrogation. Thumbwheels determine interference pulse position in microseconds following the leading edge of P_1 of the interrogation.

DOUBLE selects double interrogation when S-1403C is in DI Test Function. Thumbwheels determine spacing between interrogations.

NOTE: **** DI/INTRF ERROR *** is displayed on MENU Display (I) when DOUBLE is selected on DBL INTERR/INTRF PULSE Thumbwheels and S-1403C is not in DI Test Function.

NOTE: When DOUBLE is selected on DBL INTERR/INTRF PULSE Thumbwheels and suppressor pulse is activated by SUPPRESSOR ON/OFF Switch (17), the first interrogation is omitted. Thumbwheels determine delay from suppression pulse to second interrogation.

43. DISPLAY SELECT Readout

Displays ATC-1400A transmitting frequency, PRF or UUT reply code data as selected, on the DISPLAY SELECT Control (40).

44. XPDR P_2/P_3 DEV Thumbwheels

Deviates position, in microseconds, of P_2 and/or P_3 pulse from nominal according to XPDR DEV P_2/CAL Switch (29) and/or XPDR DEV P_3/CAL Switch (25).

ITEM DESCRIPTION

45. FREQ/FUNCTION SELECT Thumbwheels

Set to XPDR function for Mode S Test System operation. Frequency is set from 962 to 1213 MHz (1030 MHz nominal).

46. DME-PRF Hz/XPDR-%REPLY Display

Displays total UUT percent reply, but is inaccurate because Mode S squitters are included. For accurate percent reply, refer to S-1403C Control Menu #1, ***%Reply:*** field.

48. ΔF Thumbwheels

Deviates ATC-1400A transmitting frequency -9.99 to +9.99 MHz from frequency set on FREQ/FUNCTION SELECT Thumbwheels (45).

49. XPDR PULSE WIDTH Thumbwheels

Sets width, in microseconds, of selected P_1, P_2, P_3 and P_5 pulses.

50. SLS/ECHO Thumbwheels

Selects amplitude of SLS pulses (P_2, ATCRBS or P_5, Mode S) when SLS/ECHO ON/OFF Switch (18) is ON.

Selects amplitude of P_2, P_3 or P_4 if set to VAR in appropriate S-1403C Control Menu #1 field and the SLS/ECHO ON/OFF Switch (18) is OFF.

Selects amplitude of interference pulses when activated by DBL INTERR/INTRF PULSE Thumbwheels (42) regardless of SLS/ECHO ON/OFF Switch (18) setting.

Range is from -19 to +9 dB with respect to level of P_1 of the interrogation.

51. XMTR FREQ MHz Display

Continuously displays average frequency of RF pulses received in UUT replies. Pulses measured are selected by S-1403C Control Menu #2, ***Pulse Power Gate:*** field when F_2/P_2 F_1/P_1 Switch (34) is set to F_2/P_2 position. Only the frequency of F_1, ATCRBS or P_1, Mode S is measured and displayed when F_2/P_2 F_1/P_1 Switch (34) is set to F_1/P_1 position.

53. GPIB Connector

24-pin female connector conforming to IEEE Standard 488-1978 for interface of general purpose programmable instrumentation.

54. GPIB ADDRESS Dip Switches

Eight segment DIP switch used for setting IEEE-488 bus address for remote control mode of operation.

ITEM DESCRIPTION

57. AC INPUT Connector

Connects ac power from S-1403C to ATC-1400A.

66. SELF-INTERR/OFF Switch

Set to OFF for Mode S Test System operation.

71. IFR BUS Connector (J9105)

25-pin female connector provides communication and control data between the ATC-1400A and S-1403C through IFR BUS Connector (O).

72. AUXILIARY Connector (J9106)

25-pin female connector provides timing and pulse signals between the ATC-1400A and S-1403C through AUXILIARY Connector (JJ).

73. DABS INPUT Connector (J9101)

SMB type connector receives DPSK modulation from the S-1403C through DPSK OUT Connector (II). The bipolar DPSK signal modulates the ATC-1400A RF signal to provide Mode S interrogations.

75. EXTERNAL MEASUREMENT GATE Connector (J9103)

SMB type connector receives the PPMG pulse from the S-1403C through MEASUREMENT GATE OUT Connector (HH). The PPMG pulse triggers the ATC-1400A to measure UUT reply pulse power and frequency. Power measurements are displayed on XMTR PWR WATTS Display (1). Frequency measurement is displayed on XMTR FREQ MHz Display (51).

76. RF LEVEL INPUT Connector (J9104)

SMB type connector receives additional RF level control from the S-1403C through RF VERNIER OUT Connector (GG). The ±3 dB vernier controls the signal level transmitted through RF I/O Connector (9).

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3. Performance Evaluation

A. General

The Performance Evaluation verifies S-1403C display and Mode S Test System front panel control operation. The Performance Evaluation Procedure is a covers-on test designed to give the user a high level of confidence the Mode S Test System is operating properly. Use the Performance Evaluation when the operating condition of the Mode S Test System is in question or when orientation to the Mode S Test System is desired (new or infrequent user). The Performance Evaluation Procedure requires approximately three hours to perform.

Refer to 1-2-2, Figure 6 for S-1403C (alphabetic character identifiers) controls, connectors and indicators. Refer to 1-2-2, Figure 7 for S-1403C Keyboard (B) references. Refer to 1-2-2, Figure 17 for ATC-1400A (numeric character identifiers) controls, connectors and indicators.

B. Pre-Operational Conditions

Read all steps prior to performing the Performance Evaluation Procedure.

Connect the S-1403C to the ATC-1400A according to 1-2-1D.

C. Test Equipment Requirements

Appendix C contains a comprehensive list of test equipment suitable for performing the Performance Evaluation Procedure. Other test equipment meeting the specifications listed in Appendix C may be substituted for the recommended models.

NOTE: For certain procedures in this manual, the test equipment listed in Appendix C may exceed the minimum required specifications.

D. Corrective Maintenance Program

Performance checks provide a method for validating specific hardware, software and signal operation. Should the performance checks confirm incorrect operation, the S-1403C must be recalibrated according to the S-1403C Maintenance Manual or returned to an Authorized Repair Station.

E. Test Record

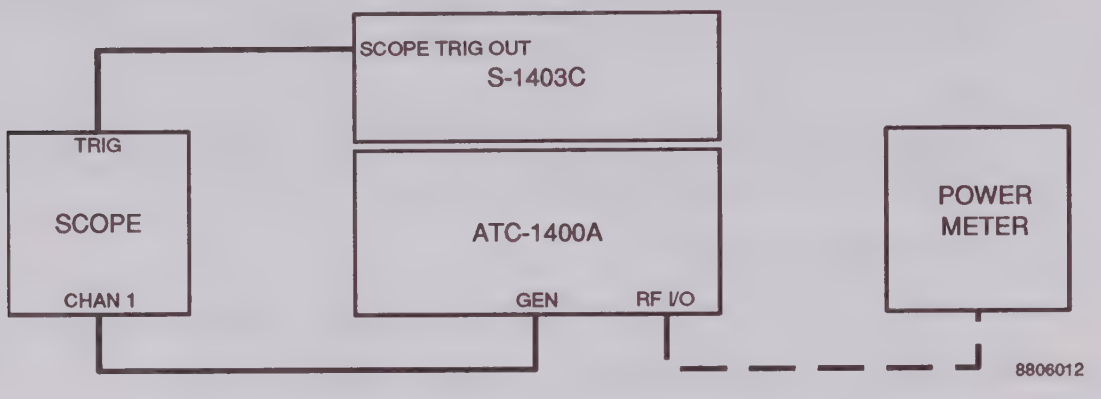
A Performance Evaluation Data Sheet is provided for recording the results obtained while performing the Performance Evaluation Procedure.

NOTE: It is recommended the technician reproduce copies of the Performance Evaluation Data Sheet, rather than use the copy in this manual.

F. Performance Evaluation Procedure

TEST EQUIPMENT:
1 Dual Pulse Generator
1 Oscilloscope
1 Power Meter
1 Spectrum Analyzer

STEP PROCEDURE



Test Function and RF Level Tests Setup Diagram
Figure 18

INITIAL CONDITIONS AND SETTINGS

1. Set ATC-1400A as follows:

CONTROL		SETTING
(7)	CW/NORM/OFF Switch	***NORM***
(18)	SLS/ECHO ON/OFF Switch	***OFF***
(22)	MAN/AUTO/MAN STEP Switch	***MAN***
(25)	XPDR DEV P_3/CAL Switch	***CAL***
(28)	XPDR DEV P_2/CAL Switch	***CAL***
(32)	PRF/SQTR ON/OFF Switch	***ON***
(37)	TACAN ON/OFF Switch	***OFF***
(38)	XPDR MODE Control	***C***
(40)	DISPLAY SELECT Control	***PRF SQTR Hz***
(41)	PRF/SQUITTER Thumbwheels	***0200***
(42)	DBL INTERR/INTRF Thumbwheels	***000.0 OFF***
(45)	FREQ/FUNCTION SELECT Thumbwheels	***1030 XPDR***
(48)	ΔF Thumbwheels	***OFF***
(66)	SELF-INTERR/OFF Switch	***OFF***

NOTE: Remaining ATC-1400A controls do not require initial settings.

2. Connect GEN Connector (15) to Oscilloscope Channel 1 input according to 1-2-3, Figure 18.

3. Connect Oscilloscope External Trigger to SCOPE TRIG OUT Connector (AA) according to 1-2-3, Figure 18.

STEP PROCEDURE

4. Apply power to Mode S Test System.

S-1403C TO ATC-1400A COMMUNICATION

5. Verify MENU Display (I) shows the Firmware Version screen for less than 30 seconds.

6. After initialization period has ended, verify MENU Display (I) shows Control Menu #1 for ATC Test Function. Refer to 1-2-2, Figure 8.

7. Set FREQ/FUNCTION SELECT Thumbwheels (45) to ***TAC Y***.

8. Verify **** DME MODE *** error indication flashes in top line of MENU Display (I).

9. Set FREQ/FUNCTION SELECT Thumbwheels (45) to ***XPDR***.

10. Verify MENU Display (I) shows ATC Test Function Control Menu #1.

ATC TEST FUNCTION

11. Set T_O/TAC/T_D Switch (30) to ***To***.

12. Verify P_1 leading edge to P_3 leading edge is 21.0 µs (±10 ns).

13. Position XPDR MODE Control (38) to ***A***.

14. Verify P_1 leading edge to P_3 leading edge is 8.0 µs (±10 ns).

15. Press 2ND, P3 and ON/CAL Keys in sequence to set Control Menu #1 ***P3:VAR***.

16. Adjust SLS/ECHO Thumbwheels (50) and verify P_3 level changes accordingly.

17. Press ON/CAL Key to set Control Menu #1 ***P3:OFF***.

18. Verify P_3 is not displayed on Oscilloscope.

19. Press ON/CAL Key to set Control Menu #1 ***P3:CAL***.

20. Set SLS/ECHO ON/OFF Switch (18) to ***ON*** and SLS/ECHO Thumbwheels (50) to ***+0***.

21. Verify P_1 leading edge to P_2 leading edge is 2.0 µs (±10 ns).

22. Adjust SLS/ECHO Thumbwheels (50) and verify P_2 level changes accordingly.

23. Set XPDR DEV P_2/CAL Switch (28) to -Δ.

24. Adjust XPDR P_2/P_3 DEV Thumbwheels (44) and verify P_2 position changes accordingly.

25. Set XPDR DEV P_2/CAL Switch (28) to +Δ.

STEP PROCEDURE

26. Adjust XPDR P_2/P_3 DEV Thumbwheels (44) and verify P_2 position changes accordingly.

27. Set XPDR DEV P_2/CAL Switch (28) to ***CAL***.

28. Set XPDR DEV P_3/CAL Switch (25) to $-\Delta$.

29. Adjust XPDR P_2/P_3 DEV Thumbwheels (44) and verify P_3 position changes accordingly.

30. Set XPDR DEV P_3/CAL Switch (25) to $+\Delta$.

31. Adjust XPDR P_2/P_3 DEV Thumbwheels (44) and verify P_3 position changes accordingly.

33. Set XPDR DEV P_3/CAL Switch (25) to ***CAL***.

34. Set XPDR PULSE WIDTH VAR/CAL Switch (20) to ***VAR***.

35. Adjust XPDR PULSE WIDTH Thumbwheels (49) and verify P_1, P_2 and P_3 pulse widths change accordingly.

36. Set SLS/ECHO ON/OFF Switch (18) to ***OFF***.

SEQ TEST FUNCTION

37. Press 2ND, FUN NO and "2" Keys in sequence.

38. Verify MENU Display (I) shows Control Menu #1 for SEQ Test Function. Refer to 1-2-2, Figure 9.

39. Press S MENU Key.

40. Verify Sequence Menu S01 displays UF00 defined format. Refer to Appendix B, Figure 1.

41. Use SLEW Control (F) to enter Sequence Menu S02.

42. Verify Sequence Menu S02 displays UF04 defined format. Refer to Appendix B, Figure 2.

43. Press ON/CAL Key to set ***S02:OFF***.

44. Use SLEW Control (F) to enter Sequence Menu S03.

45. Verify Sequence Menu S03 displays UF05 defined format. Refer to Appendix B, Figure 3.

46. Press ON/CAL Key to set ***S03:OFF***.

47. Use SLEW Control (F) to enter Sequence Menu S04.

STEP	PROCEDURE

48. Verify Sequence Menu S04 displays UF11 defined format. Refer to Appendix B, Figure 4.

49. Press ON/CAL Key to set ***S04:OFF***.

50. Use SLEW Control (F) to enter Sequence Menu S05.

51. Verify Sequence Menu S05 displays UF16 defined format. Refer to Appendix B, Figure 5.

52. Press ON/CAL Key to set ***S05:OFF***.

53. Use SLEW Control (F) to enter Sequence Menu S06.

54. Verify Sequence Menu S06 displays UF20 defined format. Refer to Appendix B, Figure 6.

55. Press ON/CAL Key to set ***S06:OFF***.

56. Use SLEW Control (F) to enter Sequence Menu S07.

57. Verify Sequence Menu S07 displays UF21 defined format. Refer to Appendix B, Figure 7.

58. Press ON/CAL Key to set ***S07:OFF***.

59. Use SLEW Control (F) to enter Sequence Menu S08.

60. Verify Sequence Menu S08 displays UF00 defined format. Refer to Appendix B, Figure 8.

61. Press ON/CAL Key to set ***S08:OFF***.

62. Use SLEW Control (F) to verify Sequence Menus S09 through S16 are ***OFF***. Press ON/CAL Key if necessary.

63. Return to Sequence Menu S01 and verify ***S01:FMT D, UF#00***.

64. Verify P_1 leading edge to P_2 leading edge is 2.0 µs (±10 ns).

65. Verify P_1 leading edge to P_6 leading edge is 3.5 µs (±10 ns).

66. Verify P_2 leading edge to Synchronous Phase Reversal (SPR) is 2.75 µs (±10 ns).

67. Press 2ND, P2 and ON/CAL Keys in sequence to set Control Menu #1 ***P2:VAR***.

68. Adjust SLS/ECHO Thumbwheels (50) and verify P_2 level changes accordingly.

69. Press ON/CAL Key to set Control Menu #1 ***P2:OFF***.

70. Verify P_2 is not displayed on Oscilloscope.

STEP PROCEDURE

71. Press ON/CAL Key to set Control Menu #1 ***P2:CAL***.

72. Press 2ND, P4(P6) and ON/CAL Key to set Control Menu #1 ***P6:OFF***.

73. Verify P_6 is not displayed on Oscilloscope.

74. Press ON/CAL Key to set Control Menu #1 ***P6:CAL***.

75. Press CURSOR Key (→) (A) and ON/CAL Key to set Control Menu #1 ***P6:CAL,Wd= +0.00***.

76. Use SLEW Control (F) to adjust ***P6:,Wd=*** field from negative to positive and verify P_6 width varies accordingly.

77. Press ON/CAL Key to set Control Menu #1 ***P6:CAL,Wd= CAL***.

78. Press CURSOR Key (→) (A) and ON/CAL Key to set Control Menu #1 ***P6:CAL,Wd= CAL,Dv=+0.00***.

79. Use SLEW Control (F) to adjust ***P6:,Dv=*** field from negative to positive and verify P_6 position changes accordingly.

80. Press ON/CAL Key to set Control Menu #1 ***P6:CAL,Wd= CAL,Dv= CAL***.

81. Set SLS/ECHO ON/OFF Switch (18) to ***ON*** and SLS/ECHO Thumbwheels (50) to ***+0***.

82. Verify P_5 SLS pulse overlaps SPR.

83. Adjust SLS/ECHO Thumbwheels (50) and verify P_5 level changes accordingly.

84. Press 2ND, SPR and ON/CAL Keys in sequence to set Control Menu #1 ***SPR:OFF***.

85. Verify SPR is not displayed on Oscilloscope.

86. Press ON/CAL Key to set Control Menu #1 ***SPR: ON***.

87. Press CURSOR Key (→) (A) and ON/CAL Key to set Control Menu #1 ***SPR: ON,Dv=+0.00***.

88. Use SLEW Control (F) to adjust ***SPR:,Dv=*** field from a negative to positive value and verify P_5 and SPR positions change accordingly.

89. Press ON/CAL Key to set Control Menu #1 ***SPR: ON,Dv= CAL***.

90. Set SLS/ECHO ON/OFF Switch (18) to ***OFF***.

ACS TEST FUNCTION

91. Press 2ND, FUN NO and "3" Keys in sequence.

STEP PROCEDURE

92. Verify MENU Display (I) shows Control Menu #1 for ACS Test Function. Refer to 1-2-2, Figure 10.

93. Verify P_1 leading edge to P_4 leading edge is 10.0 µs (±10 ns).

94. Verify P_4 width is 0.8 µs (±10 ns).

ACL TEST FUNCTION

95. Press 2ND, FUN NO and "4" Keys in sequence.

96. Verify MENU Display (I) shows Control Menu #1 for ACL Test Function. Refer to 1-2-2, Figure 11.

97. Press 2ND, P4(P6) and ON/CAL Keys to set Control Menu #1 ***P4:VAR***.

98. Adjust SLS/ECHO Thumbwheels (50) and verify P_4 level changes accordingly.

99. Press ON/CAL Key to set Control Menu #1 ***P4:OFF***.

100. Verify P_4 is not displayed on Oscilloscope.

101. Press ON/CAL Key to set Control Menu #1 ***P4:CAL***.

102. Verify P_4 pulse width is 1.6 µs (±10 ns).

103. Press CURSOR Key (→) (A) and ON/CAL Key to set Control Menu #1 ***P4:CAL,Wd=+0.00***.

104. Use SLEW Control (F) to adjust ***P4:,Wd=*** field from a negative to positive value and verify P_4 width varies accordingly.

105. Press ON/CAL Key to set Control Menu #1 ***P4:CAL,Wd= CAL***.

106. Press CURSOR Key (→) (A) and ON/CAL Key to set Control Menu #1 ***P4:CAL,Wd= CAL,Dv=+0.00***.

107. Use SLEW Control (F) to adjust ***P4:,Dv=*** field from negative to positive and verify P_4 position varies accordingly.

108. Press ON/CAL Key to set Control Menu #1 ***P4:CAL,Wd= CAL,Dv= CAL***.

INTLCE TEST FUNCTION

109. Press 2ND, FUN NO and "5" Keys in sequence.

110. Verify MENU Display (I) shows Control Menu #1 for INTLCE Test Function. Refer to 1-2-2, Figure 12.

111. Verify ATCRBS pulse pattern consists of P_1 and P_3.

112. Use Δtime start to reference P_1 leading edge.

STEP PROCEDURE

113. Use Δtime stop to verify P_1 of Mode S interrogation occurs 200 µs (±10 ns) following P_1 of the ATCRBS interrogation.

114. Verify Mode S pulse pattern consists of P_1, P_2 and P_6.

115. Press CURSOR Key (→) (A) and "2" Key to set Control Menu #1 ***INTLCE,Ratio 1: 2***.

116. Verify two ATCRBS interrogations occur between Mode S interrogations.

DI TEST FUNCTION

117. Press 2ND, FUN NO and "6" Keys in sequence.

118. Verify * ***DI/INTF ERROR*** * indication flashes in top line of MENU Display (I).

119. Set DBL INTERR/INTRF PULSE Thumbwheels (42) to ***200.0 DOUBLE***.

120. Set PRF/SQTR Thumbwheels (41) to ***100***.

121. Verify MENU Display (I) shows Control Menu #1 for DI Test Function. Refer to 1-2-2, Figure 13.

122. Verify first interrogation ATCRBS pulse pattern consists of P_1 and P_3.

123. Press CURSOR Key (→) (A) and ON/CAL Key to set Control Menu #1 ***DI,1st=SEQ***.

124. Verify first interrogation Mode S pulse pattern consists of P_1, P_2 and P_6.

125. Press ON/CAL Key to set Control Menu #1 ***DI,1st=ACS***.

126. Verify first interrogation ATCRBS Only All-Call pulse pattern consists of P_1, P_3 and short P_4.

127. Press ON/CAL Key to set Control Menu #1 ***DI,1st=ACL***.

128. Verify first interrogation ATCRBS/Mode S All-Call pulse pattern consists of P_1, P_3 and long P_4.

129. Press ON/CAL Key to set Control Menu #1 ***DI,1st=ATC***.

130. Use Δtime start to reference P_1 leading edge.

131. Use Δtime stop to verify P_1 of second interrogation occurs 200 µs (±15 ns) following P_1 of the first interrogation.

132. Verify second interrogation ATCRBS pulse pattern consists of P_1 and P_3.

133. Press CURSOR Key (→) (A) and ON/CAL Key to set Control Menu #1 ***DI,2nd=SEQ***.

134. Verify second interrogation Mode S pulse pattern consists of P_1, P_2 and P_6.

STEP PROCEDURE

135. Press ON/CAL Key to set Control Menu #1 ***DI,2nd=ACS***.

136. Verify second interrogation ATCRBS Only All-Call pulse pattern consists of P_1, P_3 and short P_4.

137. Press ON/CAL Key to set Control Menu #1 ***DI,2nd=ACL***.

138. Verify second interrogation ATCRBS/Mode S All-Call pulse pattern consists of P_1, P_3 and long P_4.

BURST TEST FUNCTION

139. Press 2ND, FUN NO and "7" Keys in sequence.

140. Verify **** DI/INTF ERROR *** indication flashes in top line of MENU Display (I).

141. Set DBL INTERR/INTRF PULSE Thumbwheels (42) to ***200.0 OFF***.

142. Verify MENU Display (I) shows Control Menu #1 for BURST Test Function. Refer to 1-2-2, Figure 14.

143. Press CURSOR Key (→) (A) twice to move cursor under ***BURST,***(BURST Number)" subfield.

144. Press "5", "0", "0" and ENT Keys in sequence to set ***BURST,ATC, 500***.

145. Press BURST Key to activate BURST Test Function.

146. Verify ATCRBS interrogation is displayed on Oscilloscope for five seconds.

147. Press "2", "5" and "0" Keys to set ***BURST,ATC, 250***.

148. Press CURSOR Key (←) (A) and ON/CAL Key to set ***BURST,SEQ, 250***.

149. Set PRF/SQTR Thumbwheels (41) to ***50***.

150. Press BURST Key to activate BURST Test Function.

151. Verify Mode S interrogation is displayed on Oscilloscope for five seconds.

ANT A RF VERNIER

152. Press 2ND, FUN NO and "1" Keys in sequence to enter ATC Test Function Control Menu #1.

153. Connect Power Meter to RF I/O Connector (9) according to 1-2-3, Figure 18.

154. Set CW/NORM/OFF Switch (7) to ***CW***.

155. Press RF LVL, "0" and ENT Keys in sequence to set Control Menu #1 ***RFLvl:+0.0***.

STEP PROCEDURE

156. Adjust RF LEVEL Control (6) until RF LEVEL -dBm Display (3) reads ***04*** (-4 dBm).

157. Record Power Meter reading for reference level.

158. Adjust SLEW Control (F) to set Control Menu #1 ***RFLvl:+3.0***.

159. Verify Power Meter displays Step 157 reference level + 3.0 dB (±0.3 dB).

160. Adjust Slew Control (F) to set Control Menu #1 ***RFLvl:-3.0***.

161. Verify Power Meter displays Step 157 reference level - 3.0 dB (±0.3 dB).

162. Disconnect Power Meter from RF I/O Connector (9).

NOTE: Steps 163 through 172 pertain to S-1403C Test Auxiliaries without the Multi-Level Diversity option installed. Steps 173 through 194 pertain to S-1403C Test Auxiliaries with the Multi-Level Diversity option installed.

ANT B RF LEVEL TEST (without MLD option installed)

163. Connect Spectrum Analyzer to RF I/O Connector (9).

164. Adjust RF LEVEL Control (6) until RF LEVEL -dBm Display (3) reads ***50*** (-50 dBm).

165. Adjust SLEW Control (F) to set Control Menu #1 ***RFLvl:+0.0***.

166. Set Spectrum Analyzer as follows:

CONTROL	SETTING
Span	Zero
Bandwidth	3 MHz
Sweep Rate	5 or 10 µs
Log Scale	1 or 2 dB/Div

167. Set CW/NORM/OFF Switch (7) to ***NORM***.

168. Adjust Spectrum Analyzer for stable display and record signal level as reference.

169. Press 2ND, ANT B and ON/CAL Keys in sequence to set Control Menu #1 ***AntB:*** field to numerical value.

170. Disconnect Spectrum Analyzer from RF I/O Connector (9).

171. Connect Spectrum Analyzer to ANT B Connector (E).

172. Verify level equals Step 168 reference (±1 dB).

STEP PROCEDURE

ANT B RF LEVEL (with MLD option installed)

173. Connect Spectrum Analyzer to RF I/O Connector (9).

174. Adjust RF LEVEL Control (6) until RF LEVEL -dBm Display (3) reads ***20*** (-20 dBm).

175. Adjust SLEW Control (F) to set Control Menu #1 ***RFLvl:+0.0***.

176. Set Spectrum Analyzer as follows:

CONTROL	SETTING
Span	Zero
Bandwidth	3 MHz
Sweep Rate	5 or 10 µs
Log Scale	1 or 2 dB/Div

177. Set CW/NORM/OFF Switch (7) to ***NORM***.

178. Adjust Spectrum Analyzer for stable display and record signal level as reference.

179. Press 2ND, ANT B and ON/CAL Keys in sequence to set Control Menu #1 ***AntB:*** field to numerical value.

180. Disconnect Spectrum Analyzer from RF I/O Connector (9).

181. Connect Spectrum Analyzer to ANT B Connector (E).

182. Press C MENU and "2" Keys to enter Control Menu #2.

183. Verify Control Menu #2 ***Brf=-20 dBm*** and ***BrfIvl=+0.0 dB***. If not, use CURSOR Keys (A) and SLEW Control (F) to set fields.

184. Verify level is equal to Step 178 reference (±0.5 dB).

185. Disconnect Spectrum Analyzer from ANT B Connector (E).

186. Connect Power Meter to ANT B Connector (E).

187. Set CW/NORM/OFF Switch (7) to ***CW***.

188. Record Power Meter reading for reference level.

189. Use CURSOR Keys (A) and SLEW Control (F) to set Control Menu #2 ***BrfIvl=+3.0 dB***.

190. Verify Power Meter reading is equal to Step 188 reference level + 3.0 dB (±0.3 dB).

191. Use CURSOR Keys (A) and SLEW Control (F) to set Control Menu #2 ***BrfIvl=-3.0 dB***.

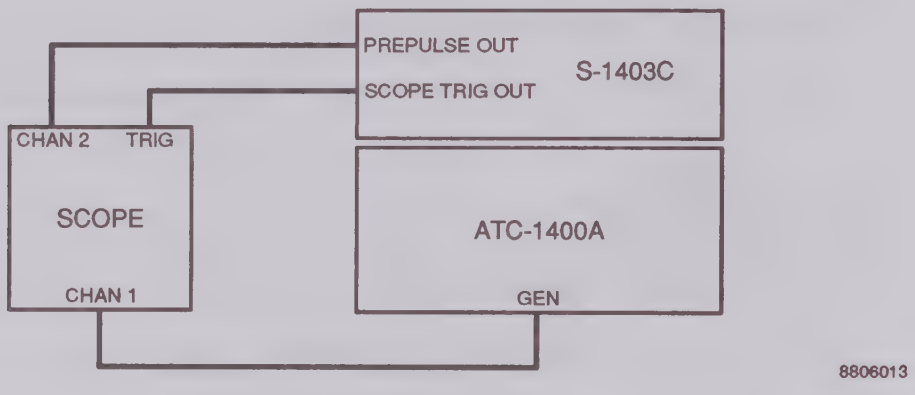
STEP PROCEDURE

192. Verify Power Meter reading is equal to Step 188 reference level - 3.0 dB (±0.3 dB).

193. Disconnect Power Meter from ANT B Connector (E).

194. Set CW/NORM/OFF Switch (7) to ***NORM***.

PREPULSE



Prepulse Test Setup Diagram
Figure 19

195. Set PRF/SQTR Thumbwheels (41) to ***200***.

196. Connect PREPULSE OUT Connector (EE) to Oscilloscope Channel 2 input according to 1-2-3, Figure 19.

197. Press 2ND, P PULS and ON/CAL Keys in sequence to activate Control Menu #2 ***Prepulse:*** field.

198. Press "0" and ENT Keys in sequence to set Control Menu #2 ***Prepulse: 0***.

199. Verify prepulse is coincident with P_1 (±100 ns).

200. Use SLEW Control (F) to set Control Menu #2 ***Prepulse:260***. Verify P_1 leading edge moves to 260 µs following prepulse leading edge (±100 ns).

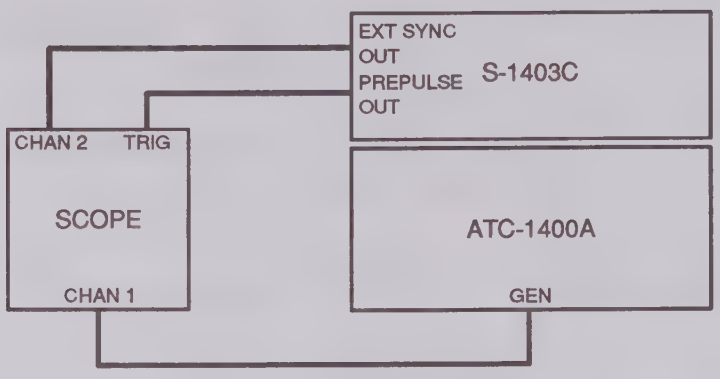
201. Disconnect PREPULSE OUT Connector (EE) from Oscilloscope Channel 2 input.

202. Disconnect SCOPE TRIG OUT Connector (AA) from Oscilloscope External Trigger.

EXT SYNC OUT

203. Connect Oscilloscope External Trigger to PREPULSE OUT Connector (EE) according to 1-2-3, Figure 20.

STEP PROCEDURE



Ext Sync Out Test Setup Diagram
Figure 20

204. Use SLEW Control (F) to set Control Menu #2 ***Prepulse: 12***.

205. Connect EXT SYNC OUT Connector (CC) to Oscilloscope Channel 2 input according to 1-2-3, Figure 20.

206. Press 2ND, EXT SYN and ON/CAL Keys in sequence to set Control Menu #2 ***Ext.Sync.:Out= ON***.

207. Press CURSOR Key (→) (A) to move cursor under Control Menu #2 ***Ext.Sync.:,Dv=*** subfield. Verify ***0.00*** is displayed.

208. Set Oscilloscope for External Trigger with both active channels displayed. Verify Ext Sync pulse is coincident with P_1 (±100 ns).

209. Use SLEW Control (F) to set ***Ext.Sync.Out= ON,Dv=+9.95***.

210. Verify Ext Sync pulse follows P_1 accordingly.

211. Press +/- Key to change ***Ext.Sync.Out= ON,Dv=-9.95***.

212. Verify Ext Sync pulse precedes P_1 accordingly.

213. Disconnect PREPULSE OUT Connector (EE) from Oscilloscope External Trigger.

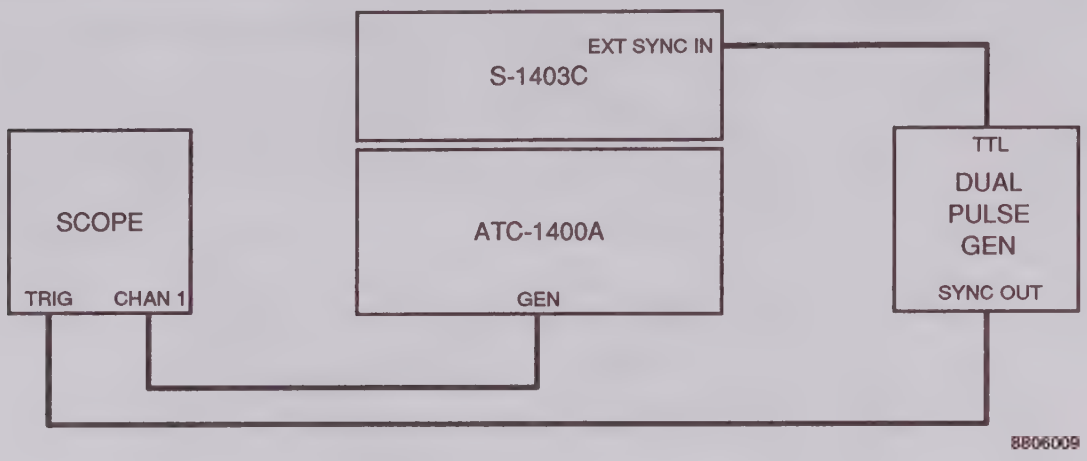
214. Disconnect EXT SYNC OUT Connector (CC) from Oscilloscope Channel 2 input.

EXT SYNC IN

215. Press CURSOR Key (→) (A) and ON/CAL Keys in sequence to set Control Menu #2 ***Ext.Sync.:,In= ON***.

216. Verify Control Menu #2 ***Ext.Sync.:Out=*** and ***Ext.Sync.:,Dv=*** subfields blank out.

STEP PROCEDURE



Ext Sync In Test Setup Diagram
Figure 21

217. Connect Dual Pulse Generator TTL Output to EXT SYNC IN Connector (BB) according to 1-2-3, Figure 21.

218. Connect Dual Pulse Generator Sync Out to Oscilloscope External Trigger according to 1-2-3, Figure 21.

219. Set Dual Pulse Generator to Single Pulse Output and Internal Sync.

220. Verify P_1 occurs approximately 7.0 µs after Oscilloscope trigger.

221. Vary Dual Pulse Generator PRF Control.

222. Verify interrogation rate tracks Dual Pulse Generator PRF.

223. Press ON/CAL Key set Control Menu #2 ***Ext.Sync.:,In=OFF***.

224. Disconnect Dual Pulse Generator Sync Out from Oscilloscope External Trigger.

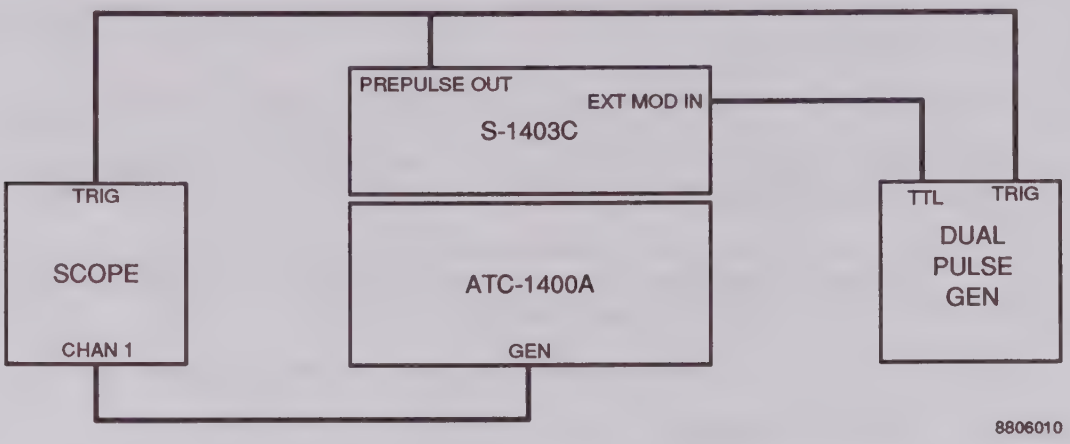
225. Disconnect Dual Pulse Generator TTL Output from EXT SYNC IN Connector (BB).

EXT MOD IN

226. Connect PREPULSE OUT Connector (EE) to Dual Pulse Generator Trigger input and Oscilloscope External Trigger according to 1-2-3, Figure 22.

227. Select External Trigger mode on Dual Pulse Generator. Set for dual pulse output.

228. Connect Dual Pulse Generator TTL Output to EXT MOD IN Connector (Z) according to 1-2-3, Figure 22.



Ext Mod In Test Setup Diagram
Figure 22

229. Press 2ND, EX MOD and ON/CAL Keys in sequence to set ***Ext.Mod.In: ON***.

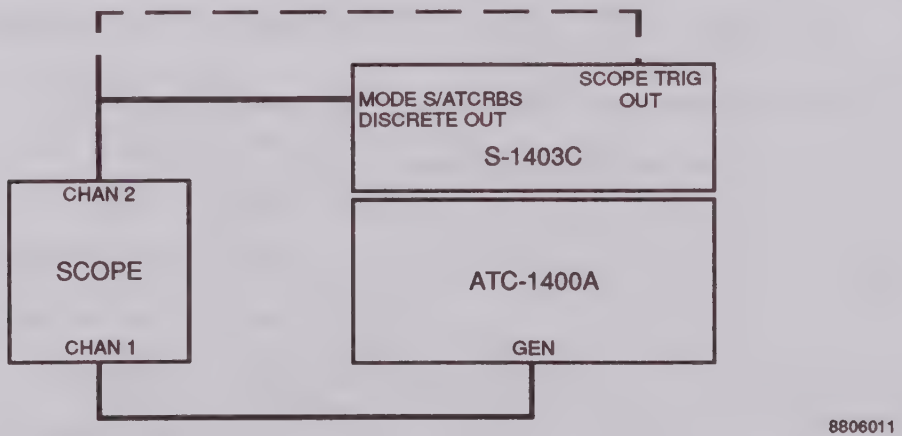
NOTE: The EX MOD Key and ON/CAL Key is the same key.

230. Verify the pulses present at GEN Connector (15) coincide with Dual Pulse Generator output.

231. Press ON/CAL Key to set ***Ext.Mod.In:OFF***.

232. Disconnect Dual Pulse Generator from S-1403C and Oscilloscope.

MODE S/ATCRBS DISCRETE



Mode S/ATCRBS Discrete and Scope Trigger Tests Setup Diagram
Figure 23

STEP PROCEDURE

233. Press 2ND, FUN NO and "5" Keys in sequence to enter INTLCE Test Function Control Menu #1.

234. Press C MENU and "2" Keys in sequence to enter Control Menu #2.

235. Press CURSOR Key (→) (A) and "1" Key to set Control Menu #1 ***INTLCE,Ratio 1: 1***.

236. Connect MODE S/ATCRBS DISCRETE OUT Connector (DD) to Oscilloscope Channel 2 according to 1-2-3, Figure 23. Select Oscilloscope Internal Trigger Channel 2, negative slope.

237. Verify 3.0 µs wide TTL active low pulse occurs 1.0 µs prior to P_1.

SCOPE TRIGGER

238. Disconnect Oscilloscope Channel 2 input from MODE S/ATCRBS DISCRETE OUT Connector (DD) and reconnect to SCOPE TRIG OUT Connector (AA) according to 1-2-3, Figure 23. Select Oscilloscope positive slope trigger.

239. Set T_O/TAC/T_D Switch (30) to ***T_O***.

240. Verify scope trigger pulse leading edge occurs before P_1 of ATCRBS interrogation.

241. Verify scope trigger pulse trailing edge occurs after P_3 of ATCRBS interrogation.

242. Set T_O/TAC/T_D Switch (30) to ***T_D***.

243. Verify scope trigger pulse leading edge occurs after ATCRBS interrogation and prior to P_1 of Mode S interrogation.

244. Verify scope trigger pulse trailing edge occurs around 132 µs following P_1 of Mode S interrogation.

245. Remove power from the Mode S Test System.

246. Disconnect test equipment.

G. Performance Evaluation Data Sheet

The following data sheet may be reproduced by individual users.

TECHNICIAN: _____ DATE: _____

ATC-1400A S/N: _____ S-1403C S/N: _____

STEP	DATA	RESULT
	S-1403C to ATC-1400A COMMUNICATION	
5.	Firmware Version screen displayed <30 seconds	_____ (√)
6.	ATC Test Function Control Menu #1 displayed	_____ (√)
8.	**** DME MODE **** error displayed	_____ (√)
10.	ATC Test Function Control Menu #1 displayed	_____ (√)
	ATC TEST FUNCTION	
12.	Mode C P_3 position from P_1 21.0 µs (19.99 to 21.01 µs)	_____
14.	Mode A P_3 position from P_1 8.0 µs (7.99 to 8.01 µs)	_____
16.	P_3 level varies.	_____ (√)
18.	P_3 is deactivated.	_____ (√)
21.	P_2 position from P_1 2.0 µs (1.99 to 2.01 µs)	_____
22.	P_2 (SLS) level varies.	_____ (√)
24.	P_2 (SLS) position moves closer to P_1.	_____ (√)
26.	P_2 (SLS) position moves away from P_1.	_____ (√)
29.	P_3 position moves closer to P_1.	_____ (√)
31.	P_3 position moves away from P_1.	_____ (√)
35.	P_1, P_2 (SLS) and P_3 pulse widths vary.	_____ (√)
	SEQ TEST FUNCTION	
38.	SEQ Test Function Control Menu #1 displayed	_____ (√)
40.	Sequence Menu S01 displays UF00.	_____ (√)

STEP	DATA	RESULT
42.	Sequence Menu S02 displays UF04.	_____(√)
45.	Sequence Menu S03 displays UF05.	_____(√)
48.	Sequence Menu S04 displays UF11.	_____(√)
51.	Sequence Menu S05 displays UF16.	_____(√)
54.	Sequence Menu S06 displays UF20.	_____(√)
57.	Sequence Menu S07 displays UF21.	_____(√)
60.	Sequence Menu S08 displays UF00.	_____(√)
26.	P_2 (SLS) position moves away from P_1.	_____(√)
62.	S09 through S16 are ***OFF***.	_____(√)
63.	Sequence Menu S01 displays ***S01:FMT D, UF#00***.	_____(√)
64.	P_2 position from P_1 2.0 µs (1.99 to 2.01 µs)	_____
65.	P_6 position from P_1 3.5 µs (3.49 to 3.51 µs)	_____
66.	SPR position from P_2 2.75 µs (2.74 to 2.76 µs)	_____
68.	P_2 level varies.	_____(√)
70.	P_2 is deactivated.	_____(√)
73.	P_6 is deactivated.	_____(√)
76.	P_6 width varies.	_____(√)
79.	P_6 position varies.	_____(√)
82.	P_5 (SLS) overlaps SPR position.	_____(√)
83.	P_5 (SLS) level varies.	_____(√)
85.	SPR is deactivated.	_____(√)
88.	P_5 (SLS) and SPR positions vary.	_____(√)
	ACS TEST FUNCTION	
92.	ACS Test Function Control Menu #1 displayed	_____(√)
93.	P_4 position from P_1 10.0 µs (9.99 to 10.01 µs)	_____
94.	P_4 width 0.8 µs (0.79 to 0.81 µs)	_____

STEP	DATA	RESULT
	ACL TEST FUNCTION	
96.	ACL Test Function Control Menu #1 displayed	_____ (√)
98.	P_4 level varies.	_____ (√)
100.	P_4 is deactivated.	_____ (√)
102.	P_4 width 1.6 µs (1.59 to 1.61 µs)	_____
104.	P_4 width varies.	_____ (√)
107.	P_4 position varies.	_____ (√)
	INTLCE TEST FUNCTION	
110.	INTLCE Test Function Control Menu #1 displayed	_____ (√)
111.	ATCRBS pulse pattern consists of P_1 and P_3.	_____ (√)
113.	P_1 of Mode S interrogation position from P_1 of ATCRBS interrogation 200 µs (199.99 to 200.01 µs)	_____
114.	Mode S pulse pattern consists of P_1, P_2 and P_6.	
116.	Two ATCRBS interrogations occur between Mode S interrogations.	_____ (√)
	DI TEST FUNCTION	
118.	**** DI/INTF ERROR **** indication displayed	_____ (√)
121.	DI Test Function Control Menu #1 displayed	_____ (√)
122.	First interrogation ATCRBS pulse pattern consists of P_1 and P_3.	_____ (√)
124.	First interrogation Mode S pulse pattern consists of P_1, P_2 and P_6.	_____ (√)
126.	First interrogation ATCRBS Only All-Call pulse pattern consists of P_1, P_3 and short P_4.	_____ (√)
128.	First interrogation ATCRBS/Mode S All-Call pulse pattern consists of P_1, P_3 and long P_4.	_____ (√)
131.	P_1 of second interrogation position from P_1 of first interrogation 200 µs (199.985 to 200.015 µs)	_____
132.	Second interrogation ATCRBS pulse pattern consists of P_1 and P_3.	_____ (√)

STEP	DATA	RESULT
134.	Second interrogation Mode S pulse pattern consists of P_1, P_2 and P_6.	_____(√)
136.	Second interrogation ATCRBS Only All-Call pulse pattern consists of P_1, P_3 and short P_4.	_____(√)
138.	Second interrogation ATCRBS/Mode S All-Call pulse pattern consists of P_1, P_3 and long P_4.	_____(√)
	BURST TEST FUNCTION	
140.	* ***DI/INTF ERROR*** * indication displayed	_____(√)
142.	BURST Test Function Control Menu #1 displayed	_____(√)
146.	ATCRBS interrogation displayed for 5 seconds	_____(√)
151.	Mode S interrogation displayed for 5 seconds	_____(√)
	ANT A RF VERNIER	
157.	-4 dBm Power Meter reference level	_____
159.	Step 157 reference level + 3.0 dB (±0.3 dB)	_____
161.	Step 157 reference level - 3.0 dB (±0.3 dB)	_____
	ANT B RF LEVEL TEST (without MLD option installed)	
168.	-50 dBm Spectrum Analyzer reference level	_____
172.	ANT B level = Step 168 reference level (±1 dB)	_____
	ANT B RF LEVEL TEST (with MLD option installed)	
178.	-20 dBm Spectrum Analyzer reference level	_____
184.	ANT B level = Step 178 reference level (±0.5 dB)	_____
188.	-20 dBm Power Meter reference level	_____
190.	Step 188 reference level + 3.0 dB (±0.3 dB)	_____
192.	Step 188 reference level - 3.0 dB (±0.3 dB)	_____
	PREPULSE	
199.	Prepulse position coincident with P_1 (±100 ns)	_____
200.	P_1 position 260 µs after prepulse (259.9 to 260.1 µs)	_____

STEP	DATA	RESULT
	EXT SYNC OUT	
207.	Ext Sync pulse is not deviated.	_____ (√)
208.	Ext Sync pulse position coincident with P_1 (±100 ns)	_____
210.	Ext Sync pulse follows P_1	_____ (√)
212.	Ext Sync pulse precedes P_1	_____ (√)
216.	Control Menu #2 ***Ext.Sync.:Out=*** and ***Ext.Sync.:,Dv=*** subfields blank out.	_____ (√)
	EXT SYNC IN	
220.	P_1 position ≈7.0 µs after Oscilloscope trigger	_____ (√)
222.	Interrogation tracks Dual Pulse Generator PRF.	_____ (√)
	EXT MOD IN	
230.	GEN Connector pulses coincide with Dual Pulse Generator output.	_____ (√)
	MODE S/ATCRBS DISCRETE	
237.	3.0 µs wide Mode S/$\overline{\text{ATCRBS}}$ discrete pulse occurs 1.0 µs prior to P_1.	_____ (√)
	SCOPE TRIGGER	
240.	T_O scope trigger leading edge occurs before P_1 of ATCRBS interrogation.	_____ (√)
241.	T_O scope trigger trailing edge occurs after P_3 of ATCRBS interrogation.	_____ (√)
243.	T_D scope trigger leading edge occurs after ATCRBS interrogation and before Mode S interrogation.	_____ (√)
244.	T_D scope trigger trailing edge occurs around 132 µs after P_1 of Mode S interrogation.	_____ (√)

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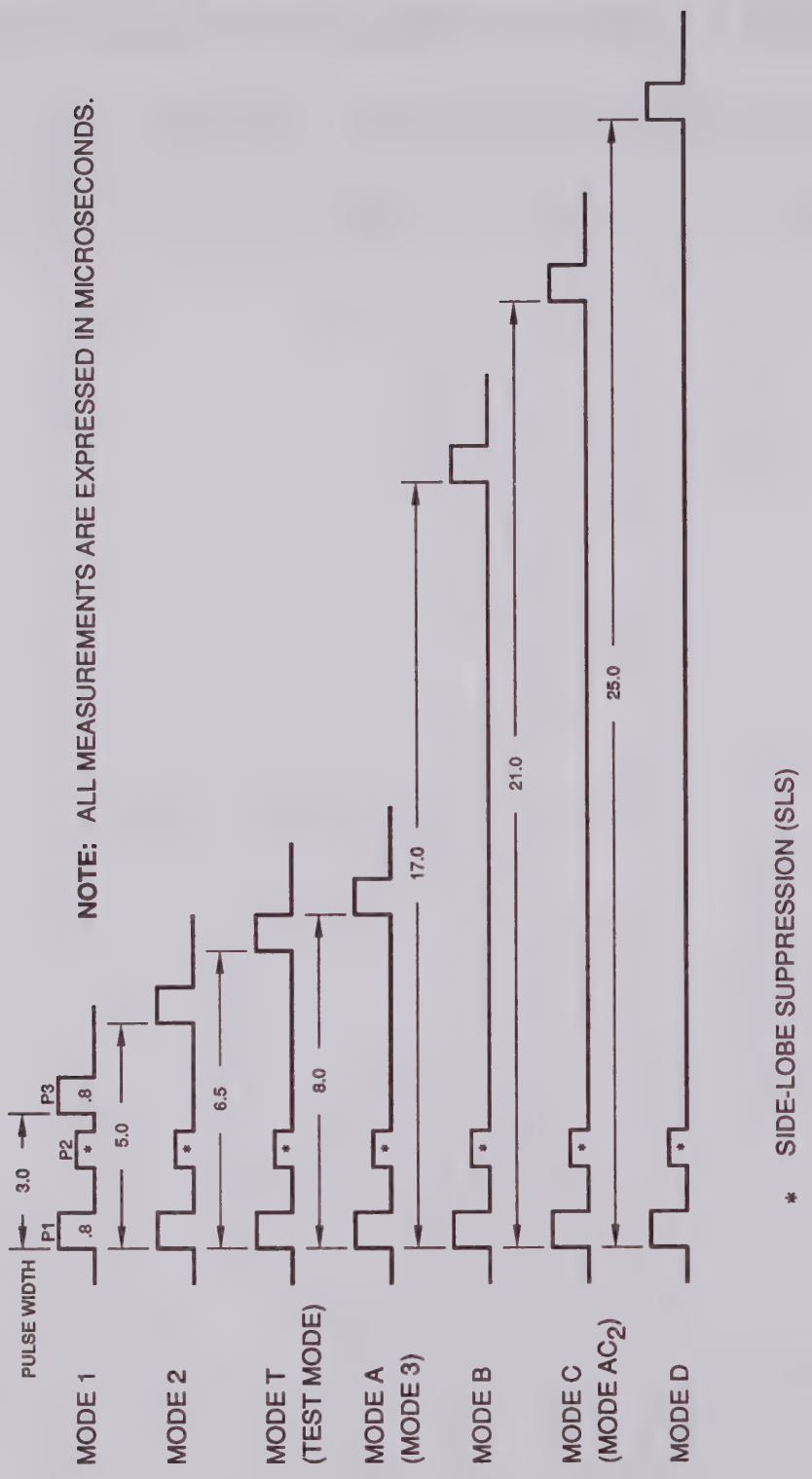
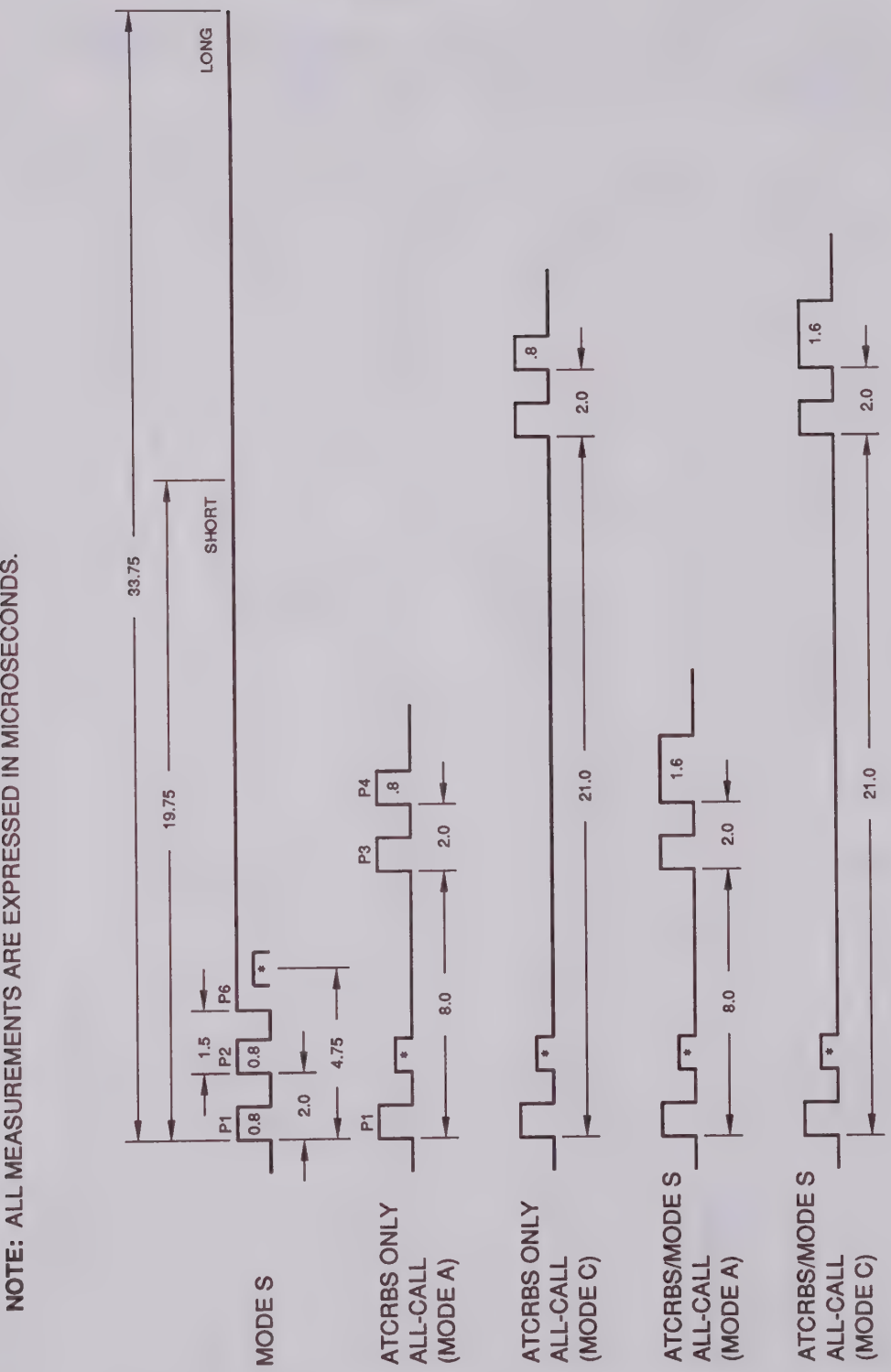
APPENDIX F - INTERROGATION AND REPLY TIMING DIAGRAMS

The following timing diagrams contain the interrogation and reply pulse patterns normally encountered by transponders operating in the ATCRBS/Mode S environment.

NOTE: ATCRBS Only All-Call and ATCRBS/Mode S interrogations may contain any valid ATCRBS P_1 to P_3 spacing. Only Modes A and C are shown in Appendix F, Figure 2.



ATCRBS Interrogations
Figure 1



NOTE: ALL MEASUREMENTS ARE EXPRESSED IN MICROSECONDS.

Mode S and All-Call Interrogations
Figure 2

Expected Replies, ATCRBS and Mode S
Figure 3

APPENDIX G - METRIC/BRITISH IMPERIAL CONVERSION TABLE WITH NAUTICAL DISTANCE CONVERSIONS

TO CONVERT:	INTO:	MULTIPLY BY:	TO CONVERT:	INTO:	MULTIPLY BY:
cm	feet	0.03281	meters	feet	3.281
cm	inches	0.3937	meters	inches	39.37
feet	cm	30.48	m/sec	ft/sec	3.281
feet	meters	0.3048	m/sec	km/hr	3.6
ft/sec	km	1.097	m/sec	miles/hr	2.237
ft/sec	knots	0.5921	miles	feet	5280
ft/sec	miles/hr	0.6818	miles	km	1.609
ft/sec^2	cm/sec^2	30.48	miles	meters	1609
ft/sec^2	m/sec^2	0.3048	miles	nmi	0.8684
grams	ounces	0.03527	miles/hr	ft/sec	1.467
inches	cm	2.54	miles/hr	km/hr	1.609
kg	pounds	2.205	miles/hr	knots	0.8684
kg/cm^2	psi	0.0703	nmi	feet	6080.27
km	feet	3281	nmi	km	1.8532
km	miles	0.6214	nmi	meters	1853.2
km	nmi	0.5396	nmi	miles	1.1516
km/hr	ft/sec	0.9113	ounces	grams	28.34953
km/hr	knots	0.5396	pounds	kg	0.4536
km/hr	miles/hr	0.6214	psi	kg/cm^2	0.0703
knots	ft/sec	1.689	100 ft	km	3.048
knots	km/hr	1.8532	100 ft	miles	1.894
knots	miles/hr	1.1516	100 ft	nmi	1.645

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CUSTOMER RECOMMENDED CHANGES TO TECHNICAL MANUALS

CUSTOMER INFORMATION

NAME (PLEASE PRINT) DATE

YOUR TITLE BUSINESS PHONE #

COMPANY NAME

BUSINESS ADDRESS

CITY STATE ZIP

PRODUCT INFORMATION

MODEL # SERIAL #

MANUAL TYPE

- ☐ OPERATOR'S GUIDE
- ☐ OPERATION MANUAL
- ☐ MAINTENANCE MANUAL
- ☐ ILLUSTRATED PARTS LIST

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